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SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 104 AUGUST, 1932 No. 8

EDITORIAL

THE FINE ART OF POISONING

POISONING was once a fine art. Students of the history of toxicology will remember that in Europe and elsewhere, at one time or another, poison was the most powerful weapon wherewith ambitious and conscienceless people achieved to political eminences. Craft accomplished then what graft does today. And in those chemistless days it was so easy to administer, even such a vicious poison as arsenic, without fear of its discovery in the corpse.

Poisoning for a purpose had its halcyon day in Italy. Indeed one spoke or wrote then, of a poisoned person as having been *italianated.* Popes and kings, princesses and queens vied with each other in the perfection of their art. When not disposed to conduct their own poison clinics they hired specialists, and in some cases gave them living material upon which to experiment and with which to conduct their demonstrations.

Toffana water, alleged to be a harmless cosmetic, was a strong solution of arsenic. Through its agency many an unsuspecting soul passed out of competition and many a brutal beast achieved to high position.

By a strange paradox this deadly lotion carried a label that bore the picture of a saint and it is not trite to remark that when properly administered it never failed in its sanctifying business.

For centuries, during the dark ages and until the science of chemistry began to make itself the practical thing it is today—inspired poisoning hastening millions to their early graves.

But not so today.

Rarely indeed do we read or hear of persons poisoned with malice aforethought. The weazened reaper rides on other nags.

The dread pellet of lead—the acutest form of lead poisoning imaginable—is in our time and place the commonest agent of murder. And we might name a few other such agencies—but none to compare with the vouched poisons of the so-called "good old days" of not so long ago.

But it was with reference to incidental and accidental poisonings that we purported to write this bit of editorial.

Consider, for instance, the insidiousness of the wholesale lead and arsenic poisonings which *must* be occurring about us in these hectic bug-killing, beetle-baiting days—when every unwashed apple carries its vicious share of toxic matter.

In the past ten years thousands of tons of arsenate of lead have been spread over our landscape in an effort to combat the Japanese beetle. Every suburban gardener sprays each season enough of the stuff to silence a city. Only the other day a keen internist called to visit a family in which two young children suffered a violent pain by poisoning, accurately diagnosed their trouble as having been produced by this dread insecticide. Eventually the children themselves recollected having eaten the red berries from a recently sprayed lonicera bush.

Under treatment recovery came, but how many such diagnoses are made? So often the symptoms are obscure and treatment handicapped.

Nicotine sulphate—indiscriminately sold for insecticide purposes in little bottles, the content of one of which would extinguish a family of ten, has also been known, even when used as a spray, to cause violent illness.

It is a strange paradox indeed—and that after all was the inciting cause of this bit of writing. A strange paradox indeed—that the pharmacist—in the eyes of the law the qualified dispenser of poisons —must needs register the sale of poisons much less vicious than those

which the corner grocer and florist can sell without the slightest inquiry or precaution.

And who can say—how frequently these insecticidal poisons have been insidiously used for inspired poisonings, let alone the damage they have silently done in their regular application.

IVOR GRIFFITH.

SELECTED EDITORIAL

A MERITED TRIBUTE

FOURTH OF JULY inevitably recalls those Colonial days in which this land was joined politically to England.

On July 3 a distinguished Englishman tarried at the beautiful Radnor home of Mr. and Mrs. Edgar McKaig, and he, in the broadest way, typifies a new and better link between these two countries.

It was Sir Henry S. Wellcome, and he now easily ranks among the world's foremost philanthropists.

No other man in Europe has done more in the past generation for the promotion of human health than has Sir Henry.

Americans should be especially interested in his work, since he was born in America and was educated at the Philadelphia College of Pharmacy and Science, graduating there in 1874.

In the field of medical research Sir Henry—known to Philadelphians until recently as Dr. Wellcome—ranks well with that other transplanted American, Gordon Selfridge, foremost merchant in London.

There was a double reason why Sir Henry before returning to England stopped at Radnor to visit the McKaigs.

Mrs. McKaig's father, the late Howard B. French, and Sir Henry were close friends.

Mr. French, as you know, was not only a leader here in the chemical industry, but for years was doing Trojan work to promote the upbuilding of the Philadelphia College of Pharmacy—the first school of that kind established in the United States.

Sir Henry S. Wellcome's education as a pharmacist in Philadelphia soon made him realize the truth of the great Pasteur's dictum:

> "Men of science without laboratories are as soldiers without arms."

So for years past Dr. Wellcome—he was knighted only recently—has devoted his money and his energies in creating laboratories for the study of disease.

Just the other day was laid in London the cornerstone for a great new research institution.

This is only the latest and greatest of many founded by him during the past forty years.

Scarcely had General Kitchener recaptured Khartoum when Dr. Wellcome founded there the Tropical Research Laboratories in connection with the Gordon College.

He had fitted out a boat which plied the mighty Nile and its upper tributaries.

It was fitted as a laboratory, the idea being to study tropical diseases, which were then a more deadly menace to the white man than all the bullets and spears of fanatical natives.

Results were in some cases astounding. As Dr. Wellcome well knew, a little prevention would be worth infinitely more than tons of ineffective cure.

Since then it has been just one laboratory after another for Sir Henry.

You may see one doing excellent service at Panama.

It is refreshing to know that while the whole world is staggering under the weight of industrial and financial depression, the labors for human welfare by such as Sir Henry S. Wellcome go forward without a halt.

Which, after all, is a far better than incessant gloom added to French and Japanese sword rattling.—(*Reprinted from the Philadelphia Inquirer.*)

ORIGINAL ARTICLES

AQUA PHILADELPHICA*

By Ivor Griffith, P. D., Ph. M.

Associate Professor of Pharmacy, Philadelphia College of Pharmacy and Science; Professor of Organic Chemistry, Wagner Free Institute of Science

Water—water—everywhere,
And all the boards did shrink.
Water, water, everywhere,
Nor any drop to drink.

THE MODERN Philadelphia preacher has developed a quaint technic. He will choose for his text a vibrant verse from the Song of Solomon, and then proceed with a somber monologue that starts with Job's lament, and ends with a moan from Jeremiah.

Ivor Griffith

And so stealing a leaf from the preacher's book, and perhaps going the cleric one better, the lecturer this evening publicly announces his intention to wander far afield from his chosen text, and he admits that the limiting title was only chosen as a sort of a peg whereon to hang a dizzy patchwork discourse.

Geographically and chronologically we refuse to be governed by so inane a thing as a lecture title, and thus we commence our voyage on water far from Philadelphia—and farther yet from the present era—hoping, however, to return anon, to the here and the now for a sufficient span of time to view, for a while at least, Philadelphia's water line.

We shall even seek to go beyond the charted seas of history recorded—to wander and wonder awhile in "fancy's aerie car" and see how water first came to be.

According to that great group of guessers, the nebular hypotheticators, headed by the great Frenchman LaPlace, the earth was once devoid of water.

*One of a Series of Popular Science Talks given at the Philadelphia College of Pharmacy and Science, 1932 Season.

All one has to do is to picture this world primordial—let us say a billion or two years ago—a hot ball of matter, broken here and there with fissures from which issued streams of molten rock. The original thin atmosphere has enlarged, and finally there has come a time when the water vapor produced by the electric union of hydrogen and oxygen arrives at dew point—and down comes the first shower of rain that this world ever knew.

THE FIRST SHOWER

And what a hissing, steaming reception the gigantic cauldron called earth afforded this first aqueous visitor. Back to the sky the water molecules scamper, there to await until the cold dome of heaven again condensed them to a cloud.

Cloudburst after cloudburst fall like Chinese regiments, and earth is a vast distillery. At last, however, heat gives in and water gains its victory. The skin of the earth is cool, and water remains in its cavities. Hot, muddy puddles grow to dismal ponds, and ponds to lifeless lakes—the lakes in turn to become the dank primeval seas, and the seas the heaving oceans.

And yet no life.

Not a single blade of grass—not a creature on the land or in the churning water—nothing but bare, hot rock, hissing, crackling, crumbling underneath relentless showers. Fire and water are the only busy realities—and fire is now the slave and servant—and water monarch of all it surveys.

GENESIS

Life came after water. Just how—just when—just why—no one seems to know. But certain it is that water mothered all things living.

EXODUS

Certain it is too, that some day—far away—water will leave the earth again—and leave it like the moon, a cold and lifeless ball. Dr. Lowell, the famous astronomer, went so far as to describe the agonies our descendants would suffer, and the tremendous irrigation schemes which our descendants would devise as their water supply grew less and less. Possibly the canals and waterways in Mars are evidence of such a current calamity in that far distant planet. This of course somewhat discounts Tennyson's song of water, which ended with "For men may come and men may go, but I go on forever."

Genesis disposes of the creation of water with a much less verbose effort.

> "And God called the dry land earth, and the gathering together of the waters called he seas—and God saw that it was good." (Gen. 1:10.)

Since then it might be said that man has seen to it that water has not always been so "good." Someone has written that "Man is born to thrive with pure air to breathe, pure water to drink, and pure soil to live on. The impurities which render water and soil unfavorable to his own development are the product of his own life, and their removal his own responsibility."

Consider the pollution of our nearby streams and the taste of Aqua Philadelphica at certain seasons of the year! But more of that later.

The cave man was a lonely sort of a creature. Possibly the cave made him so. Yet his children, as children will (even to this generation), grew quite unlike the parents. Caves were totally too primitive and insanitary for them. They wanted modern conveniences, and indeed as men multiplied there were hardly enough caves to go around. So they built themselves huts—and huts incite to friendliness far more than caves. Not strange, then, to find that huts soon merged to villages, with all the village problems. Man was acquiring the community spirit. Neither was it strange to find that these primitive villages sprang up around those points where water was readily available, for ever since man began to think, he has set the highest value on a rich supply of pure water.

EARLY MERGERS

And when the cave man's descendants improved on their mental and physical estates, their village became a town and their town a thriving city. Today practically all the world's large centers of population are built around the early villages so intelligently located by early man, on the banks or mouths of fresh water rivers bringing their balm from the hills, and offering their fluid conduct to argosies of travel and trade.

Thus London hugs the Thames and Rome the lovely Tiber. Paris gathers round the Seine, and New York rides the Hudson. Not strange was it, that William Penn planned the City of Brotherly Love on the banks of his favorite fishing creeks—the then crystal clear Delaware, and the then cold and pure Schuylkill. And his good judgment is attested to by the fact that these two rivers have ever since filled the industrial and biologic needs of millions of those who followed him.

He might return today, but never know his rivers, nor ever hope to catch in their murky waters else than a mud-drunk catfish.

The ancients, it seems, knew a great deal more about water and other phases of hygiene and sanitation than we think they did. For instance, they knew that boiling a polluted water made it safe for drinking.

THE FIRST CUP O'TEA

Thousands of years ago the Chinese knew this, and the first pot of tea ever made was the result of a mandarin's effort to hide the mawkish taste and kill the vicious poisons of the Yangtze River water by steeping in it a few dried leaves of an evergreen shrub that grew by his garden wall.

Chin-nung, a philosopher, who lived before Confucius, wrote that "Tea is better than wine, for it leadeth not to intoxication. Neither does it cause a man to say foolish things and afterward repent them. It is better than water, for it carries no disease, neither does it act as a poison, as does water when the wells and rivers are foul with rotten matter."

BAD HABITS

Indeed, most of the so-called bad habits of all ages and climes had their origin in a protective mechanism of this kind. Fermented liquors, particularly the wines and other undistilled beverages of all peoples and periods, had been found by practice safer to drink in those days than plain water—for the alcohol in them had killed the germs of disease. The honest physiologist will say that today, since our water has been made so safe to drink, there is really no excuse for alcoholic beverages, except perhaps the alleged exhilaration. Even Lo the poor Indian smoked his pipe of tobacco long before Columbus saw America first, not so much for enjoyment as for the physiologic and psychologic protection it afforded him against the evil spirits of disease and discomfort.

Thus we may state that tea, coffee, cocoa and alcoholic beverages were originally but crude devices whereby water was made safe and seemly to drink. Yet it is not to be considered that any of these beverages are essential to normally living people. For the usual demands of a healthy human, water needs not to be teaed, nor coffeed, nor wined, nor ginned, nor sodaed, nor cocktailed. Just water—plain water, Adam's ale—satisfies every normal physiologic need. Kipling had the right idea about the universal beverage when he Gunga Dinned the well-known barrack-room ballad:

"Ye may talk o' gin and beer, when you're quartered safe out here,
And sent to penny fights and Aldershot, it,
But when it comes to slaughter, ye'll do your work on water,
And you'll lick the blooming boots of him that's got it."

Thus we have come by our bad habits quite honestly, although they have been so long a part of our nature that we variably need their stimulus—some of us a cup of tea, and some a Pittsburgh stogie, others a cup of black coffee, and *still* others a dry Manhattan.

Hippocrates nearly two thousand years ago wrote a lecture on water that is much better remembered than this one will ever be—and he advised that no water be administered to a patient except that it were just boiled. Pliny (A. D. 70) in his "Natural History," devotes considerable space to a discussion of "drinkable" water. And the remarkable achievements of the Roman government in securing for its people a safe supply of water for drinking and bathing are noteworthy in the annals of water engineering.

EARLY WATER ENGINEERS

Altogether the famous Roman aqueducts totaled nearly four hundred miles, and supplied something like a quarter million gallons of clean water to the million or so citizens of Rome. And these aqueducts, some of which are still in use, show evidences of a fair knowledge of such large scale so-called modern processes as sedimentation and filtration. The Marcian aqueduct, built in 145 B. C., was itself sixty-one miles long, and according to the aforementioned Pliny, "conferred on the city by the bounty of the gods, the cleanest of all waters in the world, distinguished both for coolness and salubrity." No Philadelphia poet, not even Tom Daly, ever grew so enthusiastic as this over Philadelphia water.

It is said that the Romans were responsible for the introduction of lead pipes as water conveyors, and that plumbism, or lead poisoning, a disease which is frequently caused by the dissolved lead in certain waters, was well known to them. Note, too, that the grand old American institution known as the plumber derives his name from that base metal, lead, although his charges are oftener in gold.

OLD MAN RIVER

Much ingenuity was shown by the ancients in connection with the storage of water for irrigation and supply in time of great droughts. Lake Moeris, a tremendous water basin in Egypt, was constructed nearly four thousand years ago, and its ruins are equally as impressive and certainly more

informing than the tight-mouthed Sphinx. "Old Man River" spells *Mississippi* to the Southern darky, but to the Egyptian peasant it only spelled *Nile,* and quite commonly famine and flood. This great artificial lake was built so as to regulate and store the annual swell of that capricious creek, thus controlling its damaging wanderlust, and at the same time saving its surplus against the day when "Old Man River" was too depressed to tend to his crops.

The valleys of the Euphrates and Tigris, too, though now wellnigh deserted, once boasted a population well advanced in civil practices. The Nahrawan irrigation canal there situated and built nearly forty centuries ago was over four hundred miles long and several hundred feet broad, and it not only supplied the aqueous and transit needs of the people, but it also converted those otherwise sterile plains and valleys into gardens of incredible beauty and productiveness.

Carthage, that proud city of Africa, also boasted a fine water supply that came from the far-away hills of Zaghoun.

And so we might go on and on with ancient records, marveling that primitive man without benefit of modern devices could have achieved to such eminences of accomplishment, and marveling too at the courage and vision and work of those who initiated and completed such enterprises.

In the pages of water history one of the most interesting chapters is that which concerns itself with the so-called "dangers" of water drinking. For the terrible water-borne plagues that decimated Europe had instilled in human hearts a real fear of water. Three centuries ago, we are told, it needed a bold man to resist the medical indictment against water drinking. Few indeed had a good word to say for it. Some did admit that one could get used to it if the habit were started early enough in life. Sir Thomas Elyot, in his book "The Castle of Health," refers to the Welshmen of Cornwall as men who "rarely drink other than common water—yet are notwithstanding, strong of body and like and live well until they be of great age."

Another medical writer of the sixteenth century parades as freaks of nature "some honorable and worshipful ladies who drink little other drink than raw water, and yet enjoy more perfect health than those who drink the strongest liquors."

Another argument for the W. C. T. U.

BIOLOGY

Where there is no water, there is no life. No matter whether life elects to serve its time in the simple single-celled amœba, or in the trillion-celled, complicated and con-

ceited creature called man—short indeed would be its stay unless it has the varied services of its versatile ambassador—water. Life comes to us wrapped up in water, and death, so often the solution of all our problems, is also always a water reaction. Indeed, water gets us even after death, for it is largely through its agency that Nature uses our substance over again in the fabrication of other creatures which are perhaps improvements over the originals.

THE WET AND THE DRY

Approximately three-fourths (73 per cent.) of the human body is water, thus a person weighing two hundred pounds, no matter how substantial a citizen he or she might be, is only about fifty pounds of real substance, and most of that is just plain bone. Think of it, every time a two-hundred-pound adult climbs upstairs to his nightly rest he is actually lugging up the staircase a few miserable pounds of dry meat, some soup bones, and five big buckets of sea water.

Plants, too, are largely water. Potatoes are three-quarters water; apples are four-fifths water, and watermelons are nearly as well stocked with water as Ivory soap is percented with purity. Total abstraction and the continued exclusion of water from any of these organizations renders them so objectionable to life that not even maggots or worms or the living germs of putrefaction or fermentation will abide in the residues.

The dried mummy of an Egyptian queen, stored in the dry sarcophagus and covered with the dry dust of centuries, lasted much longer under those conditions than it will last in the humid air of our modern museums—no matter how much embalmed it may be.

Dried foods repel decay by offering no aqueous inducement to germs of chance and change. Indeed, the whole science of food preservation by desiccation is based on the premise that life—not even bacterial life—can carry on without its drink of water.

In the animal body, water serves in manifold ways, and every tissue has its share of fluid. No physiologic action could take place without it. In the human body the distribution of water is as follows:

Blood	70%	Brain and nerves	70-77%
Muscles	75%	Hair	5%
Fat	8%	Nails	5%
Bones	14-44%		

Solvent, cleanser, purging agent, vehicle of the vital forces, regulator of body heat, lubricant, these are but a few of water's biologic functions.

LIFE AND DEATH "CUM GRANO SALIS"

In its substance, and protected by common sea salt, those microcosmic many-millioned cells, the red corpuscles, are swept to their several offices. Indeed, the comparison has already been made between blood and sea water. Let a drop of blood be added to a test tube full of distilled water, it is promptly dissolved and a clear red solution results. Every red cell is destroyed—and the picture is that of *death.*

Let another drop of blood be added to a like quantity of sea water. The liquid remains cloudy—the cells intact. Every red cell is preserved—and the picture is that of *life*

Once, so the biologists tell us, *once,* we were slimy creatures of the sea surface, floating like jellyfish on the sunless, moonless waters of the antediluvian seas. We floated indifferently in the brackish water. But now it is quite the reverse—the sea water floats in us.

WE WANT WATER

Note, too, that water depletion in the human body due to heat or over-exercise, results in that which we call thirst—and thirst is nothing but the noise of the body cells altogether yelling in physiologic language, "We want water." And they want water so as to keep their salt in safe dilution. By that token let it be recalled that plain water is a much more rational thirst quencher than alcoholic beverages of any kind, since water is a much better solvent for salt than alcohol.

Through this solvent action of water beefsteaks, bananas, bread and bologna are made soluble so that every cell in the organization receives its share of food, and through a like contrivance the needless waste products of catabolism are flushed out through the body's outlets.

FIRE EXTINGUISHER

A fact not appreciated by the average person is that the body has its own fire department like every well-ordered municipality, and that high-pressure water systems are available wherewith to fight all forms of fire. Thus a bad skin burn will immediately find the body withdrawing water from systemic circulation and spraying it on the tissues injured by the burn. This accounts for water blisters from sunburn, and the more extensive hyperemia in more severe burns.

It may be a surprise, too, for some to learn that the water in certain parts of the animal body is actually frozen. Science catalogues six kinds of ice. Kind No. 6 may exist at body temperature, though only under enormous pressure—somewhat over a hundred thousand pounds per square inch. You may believe it or not, but these enormous pressures exist in the human body because of the great affinities of body proteins for water, for much of what we erroneously call *fat* in the body is nothing but a very compact *jello*—that is, gelatin, hydrated and hard.

EVERY MAN AN ICE-MAN

Living muscles contain a great deal of water, yet not a drop of this water can be squeezed out any more than one can hope to squeeze water from a piece of ice. Scientific proof of this premise that makes every man an iceman is offered in the finding that liquid water has a dielectric constant of 80 units, whereas ordinary ice as well as most of the water in the human body show a like dielectric constant of two units.

Biologically, water is indeed a double-barreled blessing. This even-tempered liquid keeps us warm in cold days, or at least circulates our warmth, and in the torrid days of summer keeps us cool by evaporation. A glass of ice water on a boiling baseball day is a gracious blessing, but it does us twenty times the blessing afterward as it steams out as cooling sweat through a million little pores.

BY THE SWEAT OF THY BROW

Through this simple agency of water evaporation, the body is kept to its normal tone and temperature, a narrow range of about 10 degrees Fahrenheit. Sweating robs the body of heat, and thus come cool and comfort. A drop of water as sweat evaporated on the skin takes away as much heat as would be sufficient to raise two other drops of water beyond the boiling point. There are about five hundred sweat glands to a square inch of skin, and all patrolled by nerve detachments. If the blood supply becomes warmer than the normal body temperature, the thermostat operates, the sweat glands are set in action and evaporation soon reduces the blood heat to normal—when the sweat glands close down again.

Mum's the word, and B. O. the abbreviation, but it may be a surprise to some to learn that the normal adult in a normal atmosphere, even when at rest, perspires nearly a quart of water a day, let alone the water waste eliminated by the kidneys. And a hard-working adult,

such for instance as a professor, will perspire as much as two to five quarts in a twenty-four-hour summer day—that is, of course, assuming that he eats and drinks sufficient moisture during that period to afford this bulk of sweat.

Nor must we be misled into believing that all water secreted from the organism is fed *as such* in food or fluid—for a greal deal comes from food combustion. Thus, sugar burns in the body yielding half its weight of water. A person in repose will take into his body a total of about five quarts of water per day, two quarts in the form of drink and three quarts in the form of food.

This water, so necessary to health, cleanses the body of its unwanted soluble dirt, and passes out of the system as vapor, sweat and urine, the latter fluid from the sewage disposal plant of the body, amounting normally to a quart and a half to two quarts a day.

Thus is seen the need for a continuous cycling of water into the animal kingdom. Man's beverages are composed most largely of water. Water in tea, coffee, milk and beer, to say nothing of the natural water content of his flesh foods and fruit and vegetables, comprises nearly four-fifths his daily food, thus rendering it both in quantity and function by far the most important material that slides the gastronomic chute.

FOOD vs. DRINK

Indeed, if the comparison were sufferable, water is of more importance to the living body than food. A simple experiment will prove this. Two young rabbits are placed in separate cages. One is given a diet of bone-dry herbs and cereals, and not a drop of water; the other is given no food but plenty of water. The animal receiving dry food but no water will promptly languish and soon die unless liquid nourishment comes its way. The water-logged rabbit will carry on for days—long after its companion's funeral, and will return to a state of cottontail normalcy as soon as food is furnished.

At this point it will not be amiss to mention some modern opinions regarding the body's water intake. "Drink water when thirsty" and "drink water frequently rather than drink much at a time," were the aqueous aphorisms of Dr. Wiley.

DRINKING AT MEALTIME

Philip Hawk, the physiologist, smashed to smithereens the ancient prejudice against water drinking at mealtime. He favored a generous use of liquids such as milk and water at meals—taken, he advised, when no food remained in the mouth; in other words, between bites.

The temperature of water and other body imbibitions was a matter of much concern with good old Dr. Wiley. Warm water before breakfast he favored, but ice water never. He strongly advised against the drinking of water, especially in hot weather at a temperature lower than 50 degrees Fahrenheit. And so positive was he of the value of this advice that he crystallized his sentiment in song—

"Full many a dumb-bell, young and old,
Has gone to his gray sarcophagus
By pouring water icy cold
Adown his hot esophagus."

Boiled and cooled water, too, he interdicted, except in emergency, this probably because the boiling of water expels air and oxygen. It is a well-known fact that fish cannot live in cooled boiled water except it be first aerated. It is a well-known fact, too, that bottlers of distilled water aerate their product before releasing it for sale, knowing that without so doing the taste of the water would be flat.

An editorial recently appearing in the *Journal of the American Medical Association* (February, 1932) most convincingly stresses the importance of water in the dietary of human beings. It is quoted herewith.

A competent writer on diet and disease, Dr. E. F. Dubois, has recently ventured to express the conviction that the dietetic error that has killed more patients than any other is the neglect of administering enough water. He adds that in acute disease a highly colored urine is a reproach to the physician and the nurse; a dehydrated skin and tongue are danger signals. Few persons who deal with the functions of the living body, whether in health or in disease, realize that water constitutes more than 70 per cent. of protoplasm, the structural basis of organic life. In health, water is not merely incidental in this connection—merely present as ballast or a reserve in the way in which fat may accumulate in the body. Water constitutes the medium in which the chemical changes of metabolism occur. As water is continually lost to the body through various paths, by way of the kidneys, bowels, lungs and skin, it is obvious that the output must be adequately replaced if a healthy "balance" is to be maintained. This means that the intelligent practitioner should have some conception of the magnitude of the factors involved in the daily exchange.

Dr. DuBois has also pointed out that when for any reason solid foods which contain so much water are cut off in disease, it is neces-

sary to supply a proportional increase in the liquid foods in order to bring the water intake up to the level of that of an ordinary person in health. In acute disease, a still further increase in water intake should be made in order to compensate for the excessive loss through the skin and lungs.

ORDER OF THE BATH

Before leaving the biology and therapy of water, note that nothing has been said of the order of the bath, nor of the therapeutic uses of water, carbonated, mineralized or radio-activated. Nor have we discussed theories regarding body disorders inflicted by the chemicals in water. These are beyond the scope and possibilities of the presentation, and so we conclude this part of the lecture with this tribute to water's paramount position in filling the biologic needs of man—

> Till taught by pain
> Men really knew not what good water's worth;
> If you had been in Turkey or in Spain,
> Or with a famished boat's crew had your berth,
> Or in the desert heard the camel's bell—
> You'd wish yourself where truth is—in a well.

Properties and Sources of Water

Water is a chemical combination of the two gases, hydrogen and oxygen, the same two elements which when combined in a different proportion produce that peculiar bleaching liquid, peroxide, through the agency of which gentlemen are said to procure their preferences.

TWO HYDROGEN, ONE OXYGEN

The chemist defines it as a colorless, volatile, odorless, tasteless liquid, acquiring, however, a blue color when viewed in thick layers. Under normal atmospheric pressure it solidifies by freezing at 0 degrees C., and boils to a vapor at 100 degrees C. It attains its maximum density at 4 degrees C. Above and below this temperature it becomes less compact by expansion. That is why ice floats on water, and this same expansion during vaporizing and freezing has played a most important part in the structure of earth during the geologic periods of change in the earth's crust.

Indeed when water becomes steam one volume of it at 100 degrees C. gives 1650 volumes of steam. It is this expansion that is used to drive the steam engine and it is thus that heat required to change water into steam is partly converted into actual work.

A peculiar property of this volatile servant of man is its ability to absorb and store heat during its conversion into vapor to such an extent that one part of this vapor at 100 degrees C. will heat over five times its volume of ice water to the boiling point, whereas one volume of boiling water at the same temperature added to one volume of ice water, only produces a temperature of 50 degrees C. The squeezing of units of heat by superpressing steam is another industrially applied property of water vapor.

Water has a comparatively low surface tension; that is its permeability or capacity to penetrate or be penetrated. This tension is easily reduced through the addition of certain solubles such as soaps, and thus is water made a better detergent and emulsifier.

THE UNIVERSAL SOLVENT

But it is the incomparable solvent action of water that is its most interesting property. With or without decomposition, it dissolves and disperses to some extent or another in almost everything with which it comes in contact, and it is because of these properties that it is the cleanser it is and the eternal nuisance that it is as well. That also is the reason for the nature of the waters of the deep—and their saltiness—and for the many continuous changes and shifts that have occurred and will occur in our universe, and the reason also for the varying compounds of natural waters.

The great solvent power of water is reflected in the plethora of chemicals, inorganic and organic, which the analytical chemist must search for in his evaluation of a water for potable or industrial uses.

At this point it will not be amiss to attempt a very brief classification and discussion of water origins, and a rough tabulation of their nature.

Rain water, well water, spring water, river water and lake water are all applicable for general use, with or without pre-treatment. Indeed, even sea water, after distillation, is used on board our warships. Rain water, essentially a distilled water, is fairly soft, though it may contain much suspended matter picked up as it descends. Shallow surface well waters are always to be viewed with suspicion, no matter where located. The ease with which they may be contaminated with sewage and surface drainage entitles them to a continued suspicion, even by the most enthusiastic camper.

A favorably reported analysis, both chemical and bacteriological, of a well sample drawn on Monday is no assurance that such a water

will be as safe a week or a month afterward. One does not have to be a *specialist* to suggest that such wells should be so constructed as to be away from any possible source of sewage contamination.

Artesian wells, which may vary in depth to several hundred feet, usually deliver a clear, cool water, free of germs, yet very high in solids. These solids frequently confer hardness on the water, and such a water is not always, in spite of its so-called purity, a healthy water to drink, nor to use industrially.

Spring waters owe their solid composition to the nature of their origin. They vary from low solid content waters to those of unbelievably high solid content. Thus there are spring waters outside the city limits which contain three times as much chemical solubles as Aqua Philadelphica. Free flow and aeration, as well as depth of origin, render these waters fairly safe to drink.

OLD MAN RIVER NOT SO CLEAR

Brook and river waters, so amenable to contamination, also derive their solids from their runway, and of course from contaminations poured into them. Aeration or oxidation through flow, is no longer considered adequate as a means of killing dangerous bacteria in streams. It used to be said that a twelve-mile flow made any water safe of bacterial pollution gathered the first mile. That statement, however, is now known to be erroneous. Indeed, the Public Health Service of the United States insists that there is no large stream in America today whose untreated water is fit to drink. And since Aqua Philadelphica is a river water—and since we are greatly interested in it from the standpoint of its drinkability and industrial application, let us turn now to a consideration of the means whereby this water is made safe and useful for us.

Aqua Philadelphica

Aqua Philadelphica is a generic designation, a more specific nomenclature being that which refers to the two varieties, Aqua Delawarensis and Aqua Schuylkilliensis—for both of these great rivers are called upon to satisfy the watery wants of the City of Brotherly Love. Roughly speaking, the Delaware supplying west of Broad Street furnishes about 55 per cent. of total consumption, the Schuylkill supplying east of Broad Street furnishes the rest.

Before considering Aqua Philadelphica too seriously, it might be well to pause sufficiently long to consider just what might be the re-

quirements of a good municipal water, safe to drink and presenting a minimum of industrial hazards.

SAFE WATER

The drinking consumer demands a water free from disease-producing germs or harmful bacteria, and reasonably free from objectionable chemical or physical impurities, and to supply such a water is the first responsibility of the city.

Industry demands a similar water, except that it is strangely true that some chemicals which might not be interdicted in drinking water can prove detrimental to certain highly specialized industries. The removal or counteraction of such substances becomes the responsibility of that particular industry, and this is often done by distillation or chemical pre-treatment.

A water analysis, in order to determine the potability or the industrial usefulness of a water, is a complicated proposition, requiring meticulous care in its performance, and is actually of no value unless intelligently and accurately conducted. And its interpretation requires just as much intelligence.

And now to view the Philadelphia water line. Every day of the week, between the two rivers, they furnish the city with about four hundred million gallons of their precious liquid, and promise enough even when Philadelphia's present population doubles, in spite of what ill-informed and panicky politicians tell us. Once, when the Indian hunted on their banks and fished in their limpid liquid, they boasted a water as pure as that of any inland stream—that of the Schuylkill, however, because of the nature of its ground source, mine acids and limestone runway, always having been harder and fuller in solids than that of its larger sister, the Delaware.

But when the white man and his works monopolized their banks, these waters soon lost their pristine clarity. Today both rivers carry sewage, and sludge and stench, and a surfeit of slimy solids. Communities and industries both cast their filth and their waste directly, though sometimes clandestinely, into the very heart of the rivers. Again it is the Schuylkill that suffers the most, for its waters are much more industrially and biologically polluted than those of the larger river.

Once upon a time, and not such a far-away time, fish abounded in these waters, and it was a poor fisherman indeed who failed to catch a fry for breakfast. Natives of Bucks County, in the neighborhood of Point Pleasant, still aver that as late as thirty years ago bass

of all varieties and the ubiquitous sunfish attended school in the upper Delaware, and only needed a hint of a worm to play hookey by running right on the fisherman's bait. Of course that may have been a fish story—but certain it is today that only a poor fish indeed would ever venture closer to Philadelphia than Lumberville or Trenton.

STRONG DRINK

Certain it is, too, that water which proves a good embalming fluid for fish is hardly fit for human stomachs. A rough classification of the industrial wastes that pollute streams gives three rather delicatessen groups of such contaminants. Here they are:

Firstly, there are the animal materials such as those from stockyards and abattoirs, packing plants, tanneries, woolen industries; second, wastes of vegetable origin such as those from cotton, paper mills, and rubber factories; third, wastes of mineral origin such as those from dye and gas plants, coal mines, chemical plants, bleacheries, etc. Gloriously enough the raw water of the Schuylkill is polluted by all three types of industrial wastes. And that makes Aqua Schuylkilliensis a pretty strong drink.

No one in his senses would ever deny that the raw water for Philadelphia as it comes into the intakes on the two rivers is anything but a compound infusion of slime and sickly sewage, totally unfit for human consumption.

Modern civilization laughs at the primitive practices of cannibals and savages, who bathed their bodies and washed their clothes in their village drinking ponds. But the pollution of Philadelphia's water sources is more savage and reeks with more filth than ever did uncivilized and primitive combination of swimming pools and drinking fountains.

Think of it, during seasons of drought unfiltered waters of the Schuylkill have been known to carry in dirt and slime and solubles almost an ounce to the gallon (7000 parts per million).

The watersheds of the Delaware and Schuylkill carry a population of nearly a million and a half, and these two creeks bring to Philadelphia every day on their way to the sea the sewage and industrial pollutions of this whole contiguous community of a million and a half people. Recall, too, that every normal adult excretes five billion B. coli every day. No wonder our creeks are dirty.

Nor must we forget that after we Philadelphians temporarily remove the muck and slime from this raw water, we return it, as

sedimented sludge and slime, from the laundered sand filters back to the rivers again—and along with it the excreta, biologic and industrial, of another two million parasites.

Our compliments to Chester and Wilmington.

TRUE!! Would you believe that Schuylkill water was once so dirty as delivered into certain parts of the city that persons used to dip their pens in it and with it write their complaints to the Water Bureau? This is almost as bad as the inference implied by the old Kansas City test for the drinkability of water. According to that test, one stuck a stick perpendicularly in the water. If on release the stick fell and floated, the water was good; if it continued to stand perpendicularly, it was not water, but just plain mud.

Before any one gets an erroneous impression, let it be said, however, that, thanks to an efficient municipal department, the Bureau of Water—Aqua Tappa, or Aqua Spigotta—as delivered to our homes and establishments in Philadelphia today is so thoroughly chemicalized and purified that it is not only absolutely safe for Democracy, but for the other political parties as well.

In 1928 every individual in the city was charged with a daily water consumption of 168 gallons of filtered water. On that basis Philadelphians might be considered painfully clean—and yet by the same token not nearly so clean as Al Capone and other Chicagoans whose per capita consumption of water during the same year averaged 270 gallons per day. We hear of the Englishman and his bath, yet the average Philadelphian is charged with three times as much water as the average Londoner.

Of course such figures lie, for they represent industrial water, fire-fighting water, and all water used for all purposes. The gross gallonage per day is divided by the population figure to secure these per capita records. One can appreciate the error of such statistics by assuming that if there were six million fleas in the city limits every Philadelphian would harbor three of them—and I know at least one Philadelphian who has none.

BOSTONESE According to one authority, American public water supplies had a comparatively recent origin. As one might expect, it was Boston, home town of the Beatitudes, that installed the first system for purifying water. That was in 1652. At this point, since we are Boston-minded, it will not be out of place to

tell what the little girl from Boston supplied when asked to recite "Little Drops of Water."

> "Infinitesimal particles of saline humective fluidity,
> Minute corpuscles of nonadhering inorganic matter
> Conjointly cause to exist the unmeasurable expanse of aqueous sections
> And the resplendent superficial area of dry solidity."

Schaefferstown, Pa., came second, in about 1732. In 1761 Bethlehem imported a Danish inventor, one Hans Christiansen, to supervise the construction and installation of the first American-made water pumps. It took nearly eight long years for Hans Christiansen to complete his job, and impatient Bethlehemites wondered whether Hans Andersen might not have done the job more quickly. In any event, Hans Christiansen is remembered as the patron saint and first of water-supply engineers on this side of the Atlantic.

In 1801, according to information supplied through Director Murdoch, perennial prince of the Philadelphia Water Bureau, Philadelphia installed the first considerable pumping plant in America. Poughkeepsie, N. Y., installed the first slow sand filter plant in 1870. A water commission in 1899 recommended filtration for Philadelphia. Testing stations were established at the Spring Garden pumping station, and at a point on the Delaware where the Torresdale filters are now located. But filtering was not applied to the entire water supply of the city until completion of the Queen Lane filter plant in 1911. A little later both chlorination and coagulation with alum were introduced. Prior to that time there had been no chemical treatment.

The plant through which the Bureau of Water serves 2,100,000 Philadelphians draws its raw water from the Delaware and the Schuylkill with a combined watershed of 9703 square miles, an area larger than the State of New Jersey. The first plant, by the way, was the apparatus, under Superintendent Latrobe, which took water out of the Schuylkill near Chestnut Street in 1799 and pumped it through a brick conduit six feet in diameter, to Broad and Market, where another pump elevated it thirty feet into a 16,000-gallon tank in an ornamental building.

By 1815 another steam pumping plant was in commission at Fairmount. In 1817 Josiah White and Joseph Gillingham, owners of the power rights at Falls of Schuylkill, offered to supply the City with 3,000,000 gallons a day for twenty years for $25,000 a year, and there-

after for $3000 a year forever, figuring on a dam above Callowhill Bridge. The city bought their rights, and Frederick Graff built the waterpower pumping plant housed in what is now the Aquarium, where the Art Museum now stands. There were then about thirty-two miles of wooden mains, some of which with its reservoir were dug up in good condition during the Broad Street subway excavations. In fact, up to 1842 only 113 miles of iron pipe had been laid. Some of that, incidentally, is still in place and in service.

According to the same authority, Philadelphia has perhaps the most complicated water problem of any of the major American cities, all factors considered. In treatment of water, in pumping, in distribution, it must solve unusual difficulties. It has wide differences of elevation, hills and hollows, two different sources of water supply, both of which are very badly polluted; it conducts the largest municipal filtration undertaking in the world, and because of the age of parts of the plant, both underground and in stations, it is greatly handicapped in getting the best results out of machinery and mains that are newer.

A PROFIT-PAYING WATER BUREAU

The plant which stands today on the books of the Water Bureau at a valuation of about $80,000,000, and the 1928 revenue of which was $6,911,045 with expenditures of $4,349,579, is not a thing of uniform and steady growth. Last year (1931) the Water Works turned in to the city a profit of over two million dollars, which according to law it cannot itself use for replacement or improvements.

It developed at first from the center out, and later from the outside in. A whole volume might be written on the various district waterworks which the extension of the city's boundaries from the original two and one-quarter square miles allotted by William Penn to take in the entire 129 square miles of Philadelphia County brought under the city system in 1854.

Philadelphia's great $80,000,000 city water plant comprises property known only vaguely to the average citizen, who accepts his water and many other blessings with the same degree of indifference and nonchalance that the mackerel accepts the ocean and the sod the early dew. Probably the East Park and the George's Hill reservoirs with their lakes of clean water ready for the mains, and the raw water basins of the Belmont filter plant at City Line and Belmont Avenue, are the most generally known to the citizenry. The basin at the Queen

Lane pumping station on East River Drive is another familiar sight and a favorite playground for youngsters.

But the 2380 miles of mains lie underground, and the dozen pumping stations and five filtration plants are widely scattered and too prosaic to attract public attention. Yet every day of 1931 an average of about four hundred million gallons of pure water passed into Philadelphia circulation.

Now, mind you, I said four hundred million gallons of pure water—and that perhaps calls for a definition, or a limitation.

PURE WATER? In the first place, there is no such thing as really pure water! The insatiate appetite of this chemical for dissolved company makes it impossible to obtain it in a state of absolute purity. Even distilled water is given the right, by the Pharmacopœia, that arbiter of drug purity, to contain ten parts per million or about one-half grain per gallon of dissolved solids—and believe it or not, that permission is given because wise chemists know that distilled water will even dissolve glass. That same authority furnishes standards for plain water for general use in extracting drugs and for other pharmaceutical and medicinal purposes.

DRINKABLE WATER!! But will it not be a surprise to the average kicking Philadelphian to know that Aqua Philadelphica—of both varieties, as delivered to our homes, is actually three times as "pure" as that which passes the high-water mark of the Government's book of medicinal standards?

Let it be said in addition that since the Book of Medicinal Standards strangely enough provides no test for the exclusion of disease-producing germs from its water—by that token Philadelphia water is vastly incomparable with it. The purified water pushed through our pipes from the water works has been treated so that there are practically no disease-producing germs left in it.

Listen—*untreated* Schuylkill water will contain anywhere from 20,000 to 100,000 live bugs per cc. (that is from 1200 to 6000 per drop); germs, bacteria, microbes—potential producers of plague and misery, let alone the infusoria, the molds, the cyclops, and other forms of strange life.

Yet by the time the engineers and chemists are done with the purification of this mass, there is usually not a self-respecting bug left in the liquid.

TYPHOID TOTALS

Typhoid fever was once a common disease hereabouts. As late as 1907 hundreds of Philadelphia persons (61 deaths per 100,000 population) died each year of typhoid fever, in spite of the improved cleanliness of living. When the filtering plants began to operate in 1908 on a half basis, the typhoid rate immediately dropped from 61 per 100,000 to 35. The next year (1909), with additional filtration, the rate came down to 22. With the beginning of chlorination in 1910 there was a further drop to 17. In 1913 the entire city supply was for the first time completely chemically controlled and the rate dropped to 16 in 100,000. Today, because of the continued improvement of the services of the department, the rate is less than 1 per 100,000.

Indeed, the medical colleges are growing worried over the prospect of having to teach their students the symptomatology and treatment of typhoid fever out of a book and without any clinical samples—unless they import them from Jersey or some other out-of-the-way place.

The truth of the matter is that the few cases of typhoid fever which do occur in Philadelphia are generally due to causes outside of the water supply. Vacationists who dumbly believe that mountain brooks and country springs contain no hazards drink to their heart's content, and the little typhoid bug slides down their gastronomic chutes and nests in their warm intestines. These strollers return from their country trips, and their vacation, to spend a month or two in a typhoid turmoil. Or sometimes typhoid comes from oysters brought up in beds that are not well aired. But certainly *not* from Aqua Philadelphica.

THE OLD OAKEN BUCKET

(As Censored by the Board of Health)

With what anguish of mind I remember my childhood,
Recalled in the light of knowledge since gained,
The malarious farm, the wet fungus-grown wildwood,
The chills then contracted that since have remained;
The scum-covered duck-pond, the pig-sty close by it,
The ditch where the sour-smelling house drainage fell,
The damp, shaded dwelling, the foul barnyard nigh it—
But worse than all else was that terrible well,
And the old oaken bucket, the mold-crusted bucket,
The moss-covered bucket that hung in the well.

Just think of it! Moss on the vessel that lifted
The water I drank in the days called to mind;
Ere I knew what professors and scientists gifted
In the waters of wells by analysis find;
The rotting wood-fiber, the oxide of iron,
The algae, the frog of unusual size,
The water as clear as the verses of Byron,
Are things I remember with tears in my eyes.

Oh, had I but realized in time to avoid them—
The dangers that lurked in that pestilent draft—
I'd have tested for organic germs and destroyed them—
With potassic permanganate ere I had quaffed.
Or perchance I'd have boiled it, and afterward strained it
Through filters of charcoal and gravel combined;
Or, after distilling, condensed and regained it
In potable form with its filth left behind.

How little I knew of the enteric fever
Which lurked in the water I ventured to drink,
But since I've become a devoted believer
In the teachings of science, I shudder to think.
And now, far removed from the scenes I'm describing,
The story of warning to others I tell,
As memory reverts to my youthful imbibing
And I gag at the thought of that horrible well,
And the old oaken bucket, the fungus-grown bucket—
In fact, the slop-bucket—that hung in the well.

—*Anon.*

Let it be said at this time that from the standpoint of potability—drinkability—with safety, Aqua Philadelphica is safer than the water of any well or spring or brook, or any other water source, uncontrolled and liable to contamination from germ-infected human or animal excreta at any time.

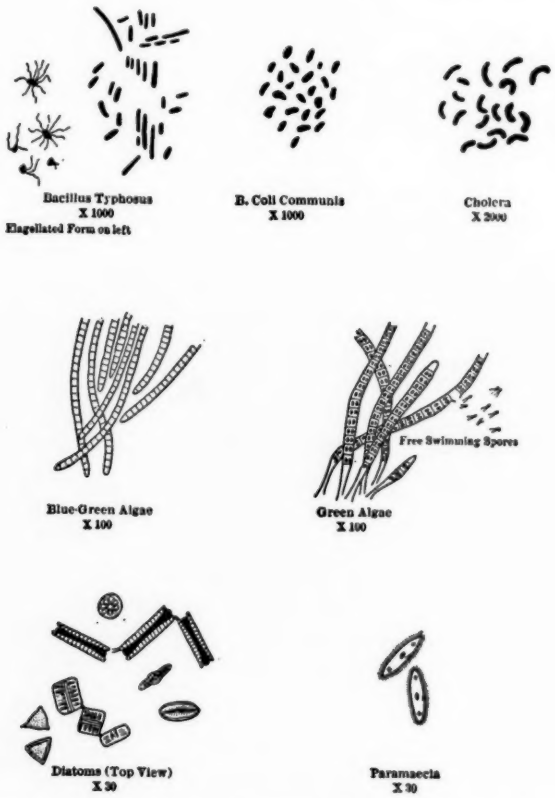
PURE SPRING WATER?

There are well-meaning Philadelphians who religiously tote suspicious-looking jugs to the so-called springs of Fairmount Park—springs that in some places originate in locations surcharged with the solubles and extrac-

tives of well-stocked cemeteries on the elevations nearby. Philadelphia health authorities had to close some of these "springs" for sanitary reasons.

Yet these jug-toting bugs swear by this water, and swear at the Bureau of City Supply, whose water, though it sometimes reeks with halitosis, is vastly safer than that of any corpse-tinctured spring in all the Park. They are ignorant of the care exercised by the scientific forces of the Water Department in making this water safe.

Thus for the control work of checking up on quality of water, the Bureau of Water maintains a modern bacteriology and chemical laboratory at the Belmont filters in which about 300 bottles of water are examined seven days a week for germ-control work; parallel



Microscopic Life in Water. The Number Below Each Group Indicates the Degree of Magnification.

(Reproduced From **Water Purification Plants and Their Operation.** Stein. John Wiley & Sons.)

chemical tests being made five and one-half days a week, and weekly gallon samples from the rivers tested.

The sampling covers about seventy points, and conforms to the specified Government standard tests. Water is examined when it is raw, when it is settled, after prefiltration, after final filtration, after chlorination, and then samples are daily taken throughout the city.

TASTE TELLS

Every day two samples are tested, hot and cold, for odor and taste. Microscopic report show in what proportion the half dozen families of Diatomaceace, Synaophyceæ, Chlorophyseæ, Protozoa, Rotifera, Crustacea, and other organisms are represented and how much amorphous organic matter is present. And the daily report also covers the turbidity or cloudiness. There is a patrol, too, which daily parades the banks of the creeks searching for sources of industrial and other pollution.

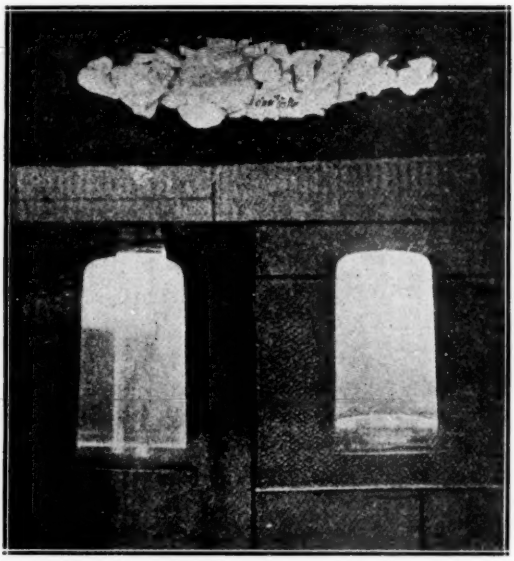
All this involves a very large amount of careful work, and the intelligent Philadelphia citizen—and that means the average Philadelphia citizen—should take a justifiable pride in the accomplishments of the Water Bureau—a bureau which has been frequently handicapped by the cheese-paring policy of petty politicians who prefer to spend municipal money in more spectacular and less substantial ways.

Typical Filtration Plant. Interior of Filter House.
(Reproduced From **Water Purification Plants and Their Operation.** Stein. John Wiley & Sons.)

How, some one asks, is it possible to make the loathsome waters of the Schuylkill and the somewhat less offensive drink of the Delaware so safe an imbibition? Briefly, this is done locally by physical and chemical processes involving aeration, sedimentation after coagulation, filtration and chlorination.

WATER PURIFICATION

Alum has a special chemico-physical property of causing a turbid water under proper conditions to coagulate and deposit its dirt and slime, thus affording a fairly clear supernatant liquid. Millions of pounds of alum (sulphate of alumina) are annually used in the first treatment of Aqua Philadelphica as it comes into the intakes. This alum in hydrating entraps the dirt by a colloidal adsorptive mechanism and causes it to settle out as this treated water rests in the preliminary settling basins. To furnish a correct alkalinity favorable to best results with the alumina clot, lime is frequently added, every addition being made, as is done with the alum, on the basis of an accurate chemical calculation. Of course some of the lime, as calcium sulphate, remains dissolved in the water. Gaseous ammonia is also frequently added in order to capture some of the offensive phenolic effluents that industrial plants illegally empty into the rivers.



Aluminum Sulphate and Coagulation.
(Reproduced From **Clean Water.** Allen Hazen. John Wiley & Sons.)

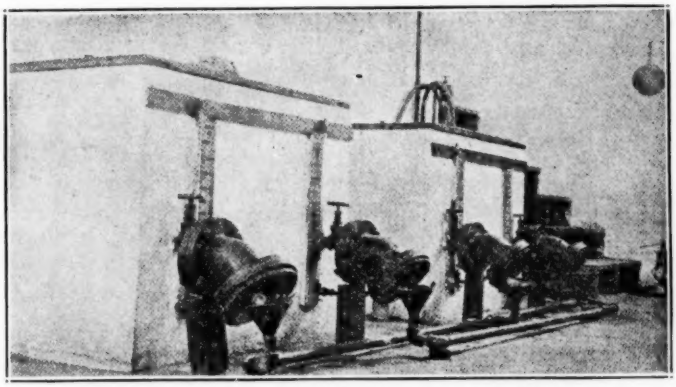
DETASTING WATER

Ammonia links up with these coal-tar products in such a way as to have them partly held back by the sand filters later in the course of treatment. What amino-phenols may then go through will link up with the chlorine, yet not producing to anything like the same degree the objectionable "disinfectant" taste that without the ammonification would have been very apparent.

There are other more or less successful methods of removing objectionable "tastes" from water. Charcoal and other absorptive and adsorptive materials are so used.

This partly purified water is now run through the sand filters, an ingenious large-scale method of removing suspended solids. Such filter beds, slow and fast working, are specially valuable because they can be conveniently cleaned, when necessary, by reversing the water flow and discarding the wash water.

After filtration comes chlorination, or chemical disinfection. This is done in Philadelphia with liquid chlorine and elsewhere with chlorine compounds. Ozone, too, is sometimes used as a chemical disinfectant. This simply means adding to water a sufficient amount of this oxidizing germ-killer chlorine, to dispose of the living germs. The efficiency of this gaseous bactericide is reflected in the fact that only two and one-half pounds of it is necessary to effect the practical sterilization of one million gallons of water, and by the time this water is delivered into the large storage basins and eventually into the varied phases of its



Measuring Tanks for Controlling the Application of Hypochlorite of Lime to Filter Effluents, Yonkers, N. Y.
(Reproduced From **Clean Water.** Allen Hazen. John Wiley & Sons.)

application, there is present much less than one-tenth of a part of chlorine to one million parts of water.

It is a safety addition, well justified. Wholesale community medication, as instituted at Rochester, N. Y., where iodine was distributed in the water supply, to curb the goitre menace, is to be deplored, but the addition of a health insurance such as chlorine has proven to be is quite proper and justifiable.

Now that our presentation has been so kind to those responsible for our water supply, perhaps it is time to preserve the dramatic unities by finding a bit of fault.

Industrially, and especially so in the textile field, a safe water supply is a prerequisite to successful production. In some respects, and particularly because of its potential alkalinity, Aqua Philadelphica is a bad actor industrially. Raw Schuylkill water is twice as hard and twice as alkaline as Delaware water, and yet we frequently find that both these waters as delivered to industrial consumers are more potentially alkaline than when the water works receives them. This of course must be due to over-liming or over-ammonification.

Not many persons are aware of the fact that Philadelphia water, practically neutral (or very slightly alkaline) cold, becomes variously and strongly alkaline when boiled, ranging in pH from 8.4 to 9.6. This alkalinity at the boil is a considerable detriment to some industrial practices. Thus in wetting down previous to dyeing and processing wool and silk, fur and other animal textiles, if the ratio between the textile and the water is high—that is, little material and much water—when the water reaches the boil it disengages at once enough alkali to cause damage and discoloration to the textile. This condition, however, can be ameliorated through adding a little organic acid, such as gluconic or citric acids, to the water before the boil, adding just enough to counteract the developed alkalinity. Care must be exercised, however, not to add too much acid, which might cause a rapid deposition of dyestuff in the fabric, with a consequent lack of penetration.

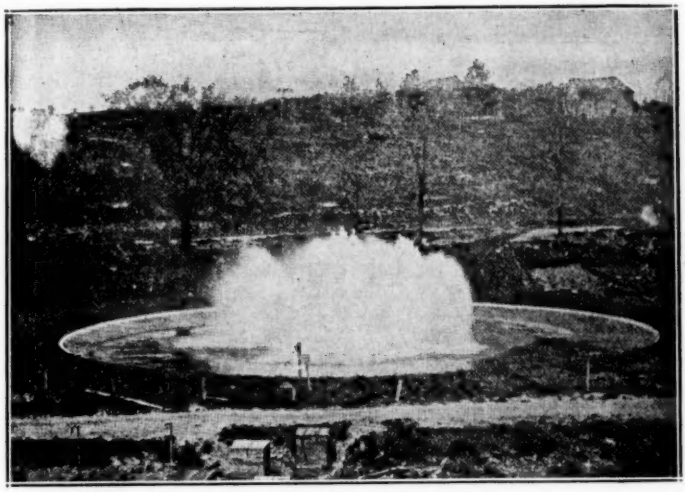
This alkalinity at the boil is also a detriment to boiler tubes and pipe lines conveying hot or boiling water, and though not generally known, softening Philadelphia water to remove calcium and magnesium salts *does not* remove this alkalinity, but actually aggravates it to such an extent that some of the zeolite softening processes cause so much hydrolysis of the carbonates and bicarbonates as to build up enough caustic alkali in the boiler to crack rivets and embrittle the plates.

DEVELOPED ALKALINITY

It is customary in some hospitals to use tap water in manufacturing normal salt solution and other operating room accessories. This is to be discouraged, for when such liquids are sterilized they actually develop enough alkalinity to raise them far beyond the range intended for them. To avoid irritation it is insisted with Dakin's solution, for instance, that it be not alkaline, yet it is a fact that sterilized Philadelphia water is far more alkaline than that famous surgical liquid, and therefore irritant as a wound dressing. Only distilled water should be used for such purposes. This is equally true of culture media whose hydrogen ion balance needs to be very accurate.

ANOTHER INDICTMENT

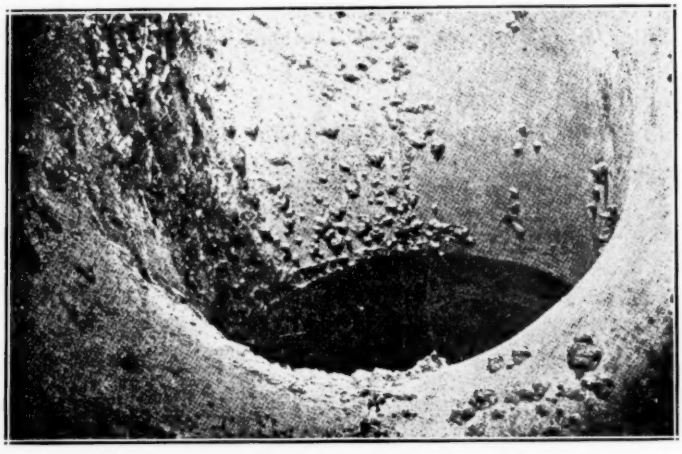
And here is one more indictment, or at least a predictional indictment of Aqua Philadelphica. New lead pipes used to convey water are at first dangerously dissolved, and especially so by soft water. However, due to solids, particularly the lime in average water, they are rather quickly made insoluble through the formation of a scale or deposit that coats the inside of the pipe. This was true of Philadelphia water, and particularly of West Philadelphia water, which is largely the limestone water of the Schuylkill, until the city resorted to the use of chlorine as previously mentioned. Since then it is a fact that the protective deposit is being slowly dissolved by the chlorine, and that eventually the bare lead will have been again exposed to the solvent action of the water.



An Efficient Aerator Temporary Bronx Supply, New York City.
(Reproduced From **Clean Water.** Allen Hazen. John Wiley & Sons.)

This would be a real calamity if it were not for the fact that not much lead pipe is being used at present. And also that our city chemists and engineers are not apt to permit the possibility of this condition ever to become an actuality. They will be ingenious enough to find a way out.

Zinc from galvanized pipe and brass is also dissolved by water, particularly by hot soft water. Iron, which constitutes the bulk of pipe lines, is also fairly soluble in certain waters, notably those containing dissolved oxygen. That is why aerated water containing a great deal of dissolved oxygen, is so hard on iron pipe. Copper pipe is possibly the most resistant of any—but we are involving our story a bit.



Tubercles Growing in Iron Water-Pipes.
(Reproduced From **Clean Water.** Allen Hazen. John Wiley & Sons.)

And so quite abruptly and after causing much aural sufferance and suffering to my patient audience, I come to the end of my water trail, which has been, after all, most incomplete. Only a chapter, and a very brief one, has been presented in the story of water, that greatest boon to mankind. A poet once averred that the complicated mechanism called woman was "God's greatest gift to man."

That was poetic license. Any chemist will tell you that God's greatest gift to man and woman, and to every living creature, is the plain, common substance of which another poet sang—and more intelligently—

"If all the land were bread and cheese,
And all the water were ink,
What would the creatures of this earth—
What would they have to drink?"

CAFFEINE IN CEREAL BEVERAGES

By Charles H. LaWall and Joseph W. E. Harrisson

"CEREAL BEVERAGES" is a term used to designate a group of products which have come into existence since the adoption of the prohibition amendment and the passage of the National Prohibition Act, commonly known as the "Volstead Law."

In the regulations issued by the Bureau of Industrial Alcohol of the United States Treasury Department and prescribed jointly by the Secretary of the Treasury and the Attorney General of the United States, the following definitions occur:

Section 1001

(a) *"Beverage" will mean a liquid fit for beverage use, produced by a process by which beer, ale, porter or wine is produced, or by any arrested fermentation process, and containing less than one-half of 1 per cent. of alcohol by volume.*

(b) *"Cereal Beverages" will mean those derived wholly or in part from cereals or substitutes therefor, such, for example, as wheat, oats, rye, barley, buckwheat, corn, rice or any other cereal or substitute therefor, produced by a process by which beer, ale or porter is produced, or by any arrested fermentation process, and containing less than one-half of 1 per cent. of alcohol by volume.*

There are other and supplementary regulations concerning the labeling of these products which read as follows:

Section 1020—Labels

"Each package or container of cereal beverages must bear a label showing:

(a) *The name of manufacturer.*

(b) *The number of the basic permit under which produced.*

(c) *The special name, if any, of the beverage. (The use of the words "beer," "ale" or "porter" is not permissible on labels for such beverages.)*

(d) *The location of the factory by city, or town, and state.*

(e) *One of the following legends must be inscribed in plain and legible letters and figures on such label:*

1. *"Alcoholic content less than one-half of 1 per cent. by volume.*

2. *"Does not contain one-half of 1 per cent. of alcohol by volume."*

3. *"Contains no alcohol."* (*In case of the use of this legend the beverage must be non-alcoholic in fact.*)

No other method of indicating the alcoholic content of such beverage containing less than one-half of 1 per cent. of alcohol by volume may be used.

This is the group of products which are popularly, but not legally known as "near beers," concerning which term the jocular remark has been made that the originator of the name was a poor judge of distance.

The fact that in their condition of low alcoholic content these beverages lack what is popularly called "authority" has led to many efforts to supplement this lack.

Many apocryphal tales abound of "shooting" alcohol or ether into the bottled beverage by the vendor just prior to the time that it is served and it has also been alleged that dissolving an "aspirin" tablet in the beverage at the time of serving gives it an apparent kick.

Within the past year or two a new plan has been adopted by some manufacturers of cereal beverages to give the product stimulating properties.

This consists in the addition of caffeine or the use of an infusion or an extract of some caffeine containing plant such as tea or maté (Paraguay tea). In some cases the process of adding the caffeine or caffeine containing ingredient is patented, but in no case that has come under our observation has the presence of the caffeine been declared.

In some instances the product has been advertised in such a manner as to give the prospective purchaser a pleasurable sense of anticipation of benefits to come.

The detection of caffeine in such beverages is a relatively simple procedure and is carried out as follows:

Method of Detecting Caffeine Qualitatively

One hundred cubic centimeters of the cereal beverage is placed in a separatory funnel, made slightly alkaline with ammonia, and then extracted with three portions of chloroform, using 25 cc., 15 cc., and 10 cc. respectively.

The chloroformic extractions are combined and evaporated to dryness on a water bath. The residue may or may not be crystalline, depending upon the amount of caffeine present. If it is crystalline the identification test is directly applied to the residue. If the residue is amorphous it is subjected to the potassium permanganate purification method as directed in the official methods of the A. O. A. C. under caffeine in roasted coffee.

The identifying test is made by adding fifteen to thirty milligrams of potassium chlorate to the dry residue in a glass dish or a watch crystal. Then add 1 cc. of hydrochloric acid. Mix thoroughly. Place the glass vessel on the water bath and evaporate the liquid to dryness. Then allow a few drops of 10 per cent. ammonium hydroxide solution to flow over the residue. The characteristic "murexide" purple color appears if caffeine is present.

The qualitative determination is accomplished by proceeding as directed above, using larger quantities of chloroform (50 cc. and 30 cc.) in the first two extractions and continuing the extraction with 10 cc. portions of chloroform until the extraction is complete as may be determined by appropriate methods familiar to those engaged in alkaloidal assay work.

Out of twenty different brands of cereal beverages which were examined during 1931, five brands contained caffeine in amounts approximating a half grain of caffeine to each bottle of the cereal beverage.

USEFUL MILK PRODUCTS AND MILK PREPARATIONS

By Louis Gershenfeld, Ph. M., B. Sc., P. D.

Professor of Bacteriology and Hygiene, Philadelphia College of Pharmacy and Science

THERE are entirely too many children suffering today from defective nutrition (being either underfed or misfed); and there are entirely too many children and adults who are not progressing properly due to faulty dietary habits, with the result that numerous disorders of one kind or another develop. Children as they are growing require the proper materials for building up new tissues and for replacing worn-out cells. An undernourished child is a fit subject who may contract disease, one who will suffer not only physically but mentally as well. Children receiving insufficient food or the wrong kind of food are not fit subjects for school education or to learn the rudiments of citizenship. It is these children who eventually are the direct cause of hundreds of other communal and governmental problems, which could be avoided, for healthy children can be trained and educated with greater ease and better results. Millions and millions of children, yes, at least six millions of them in our country are handicapped. As undernourished weaklings they are compelled to enter the race of life.

Louis Gershenfeld, Ph. M., B. Sc., P. D.

It is the consensus of opinion of all scientists that milk (or a milk product) is a food which must be present in the daily diet of all children. Detailed studies by different investigators reveal that the minimum of a quart of milk in the daily diet of children will help to build up their vigor and strength, overcome undernourishment and malnutrition, result in a normal growth and proper development, and aid in the prevention of many infections. A recent study of some representative New Hampshire boys and girls showed that only 34 per cent. eat enough fruit, only 21 per cent eat enough vegetables, and only 17 per cent. drink sufficient milk. More recently at the White House Conference on Child Health and Protection, it was revealed that only 57 per cent. of American children have enough milk each day; 3.5 per cent. use no milk at all; and the rest have less than the proper quan-

tity they should have. This, probably a fair average for boys and girls in our country, demonstrates that more education in matters pertaining to diet is needed in our schools and in homes.

Upon the food selected by the expectant and nursing mother depends not only her own health but to a large extent that of the baby she is carrying and nursing. Minerals, vitamins, etc., must be furnished for the breast milk, if they are not to be taken from the tissues of the mother. Her diet must be well balanced, and milk and milk products should form a good portion of the latter. One quart of milk daily in her diet would not be too much for the pregnant and nursing mother. Milk, the almost perfect food, containing most all of the essential elements, is desirable as one of the foods in the daily diet of adults and should be consumed in amounts of a minimum of one pint for healthy individuals to two quarts daily for those who are undernourished or diseased.

Mother's milk is to be preferred for the infant wherever possible, and breast feeding has always been emphasized as the best natural food for the newborn. Due to the fact that the latter may not be always available, even impossible, or due to abnormalities, it may be undesirable, substitutes for human milk have been introduced. For adults these substitutes are the only milk obtainable. In this country and in most quarters of the globe, cow's milk has been accepted as the best and most practical substitute for mother's milk. An abundant, safe and fresh milk supply at a reasonable cost would be the most important answer to this nutrition problem constantly confronting public health workers. But despite the real worthwhile accomplishments and wonderful progress made in obtaining such a fresh milk supply, other problems presented themselves which revealed that it was not always possible to have the latter available. There are many localities where fresh cow's milk cannot be produced in sufficient quantity to supply the local needs; others where a safe supply is almost impossible; in some areas there may not only be a scarcity, but none at all is procurable, while over a large portion of this and other countries, the cost of fresh cow's milk may be too high and thus beyond the means of a large part of the population. During traveling, it may not be possible to procure fresh milk when wanted; and even in homes, there are many householders who do not have the facilities of properly handling and preserving this liquid food.

Milk is not a seasonable product or one obtainable only at certain periods. There is always present a continuous supply of this liquid

food. The production may exceed the demand, so that it may be available in such quantities that it will go to waste. Frequently the lack of transportation facilities or the cost of the latter or the limitations of distance to which milk can be subjected during transportation are factors which account for the presence of quantities of milk more than is needed to supply the local needs.

MILK PRODUCTS AND MILK PREPARATIONS

Due to the foregoing reasons, and to conserve this important food, milk products containing much if not all of the excellent nutritive value of the original liquid milk have been made available at a reasonable cost. Market milk can be readily changed into these useful preparations. If prepared properly, they will be found to be safe products possessing distinct value and they should come into wider use. These milk products are essential today more so than ever before to save the child and even adult victims of the depression from lasting injury to their health. It is imperative that they should be fed in larger quantities now when the family purse is low and the ordinary standards of diet may consequently be sacrificed. These preparations give most food value for money expended. People should also realize that because some of these milk products are less expensive than other foods, there is no reason to believe that they are not as beneficial to our health and welfare. Expensive foods may satisfy pride and palate, but there is not usually any relationship between nutritive value and price, and it is unwise to be prejudiced against less expensive foods.

There is another reason why milk products should be more frequently employed than they are at present. Even though all kinds of educational and advertising programs have been instituted that milk, though a liquid, contains more actual nutritive materials than do many of the "solid" foods, there are entirely too many people who still harbor the erroneous belief that milk is not as satisfactory as are solid foods. Others regard milk as a beverage or drink merely because it cannot be chewed like meat or bread. The result is that there are pronounced preferences, and liquid milk is excluded from the diet of many adults. It must also be recognized that the value of milk products, many of which are solids, have not been brought as forcibly to the attention of these individuals as they might have been. There is still lacking the proper appreciation and recognition of these preparations as valuable foods in our diet. It is also discouraging to observe that as children mature, their consumption in liquid milk is lowered

and gradually equals that of adults. At the same time there is no marked increase in the consumption of milk products. The child, watching the adult, replaces the use of milk by other beverages as coffee, tea, etc. The use of the latter seems to him to be indicative of attainment of full maturity.

Aggressive sales efforts have aided somewhat in the increase of the per capita milk consumption. We must, however, conclude that the efforts expended in perpetuating and further increasing this expansion, based solely upon the stimulation of a milk-drinking habit, have not really warranted so enormous an outlay of funds. It seems to me that the large potential market of milk products as worthwhile dairy preparations for cooking, baking and eating purposes, has not been presented properly. There is considerable to be gained here not only as an outlet for the use of milk but as a more effective agency of increasing the consumption of worthwhile milk constituents to be used by adults and children, poor and rich, those who indulge in liquids and those who partake in but small volumes of liquids—individuals who have and those who haven't the facilities of proper refrigeration, in environments regardless of climatic conditions and whether one is on land, sea, etc., to be employed anywhere, any time. These milk products have a definite place in the scientific scheme of human nutrition. In the long run their use may require less efforts of helping child and adult to get the necessary milk constituents which ought to be in their daily regimen. A more effective publicity should be inaugurated to inform everyone concerning the use and economy of dairy products in the diet.

Humans have been making some of the milk products mentioned later for many thousands of years, but it is only in the past fifty years and even less that machinery has been extensively adapted to this ancient craft.

MILK PRODUCTS AND DISEASE

It is known that disease-producing bacteria may be present in milk. Diseases traced to the use of infected milk are: typhoid and paratyphoid fevers, diphtheria, scarlet fever, septic or streptococcus sore throat, dysentery, diarrheal and other gastro-intestinal disorders, and foot and mouth disease. Malta fever and undulant fever are also milk-borne. It has also been proven that tuberculosis can be transmitted by infected milk.

With the introduction of elaborate methods of inspection and sanitary regulations, pasteurization, etc., the total bacterial content in

milk has been reduced to a minimum and there has been introduced a marketable product reasonably safe from infection. Pathogenic bacteria which occur in milk may, of course, find their way into milk products. It is therefore essential to see that the starting point in the production and manufacture of milk products should be in the procuring of a good quality, clean and properly safeguarded milk supply. This will eliminate to a very great extent the possibility of milk products aiding in the dissemination of infections. It must, however, be remembered that with the growth of the output of milk products, the complicated methods of preparation, packing, and distribution, new avenues of possible infection present themselves and difficulties arise of properly controlling the safety of the marketed article. It is therefore apparent that the various milk products, just like other foods, may be infected independently after manufacture. However, additional essential safeguards have been introduced, resulting in the presentation of supplies of milk products safe from infection. Such precautions to prevent these chance contaminations are especially necessary in the case of foods which as these are commonly eaten without cooking. The layman should remember the following facts:

Flies have been noted in many outbreaks of milk-borne infections as a possible means of conveying disease-producing organisms to milk products. It is therefore of great import to see that the latter are placed in covered receptacles at all times. Opened cans of condensed or evaporated milk, opened containers and uncovered dishes holding butter, cheese, etc., should not be tolerated. Purchases of these products should be made preferably buying the latter in unopened or sealed containers, and then they should be kept under cover at all times.

It must be remembered that carriers of disease-producing organisms are always in our midst. It is obviously desirable that they be prevented from handling milk and its products. Such regulations are observed in the large dairy establishments, but in many smaller places and in retail stores examinations to detect carriers are not conducted. Even though a pasteurized and safe milk was employed as a starting point and all sanitary regulations were observed in manufacture, those milk products which are not subjected to heat after preparation may in some instances become infected due to the presence of a careless carrier who as an employee was in contact with the finished product. It must be remembered that many of the milk preparations and products are consumed without cooking or heating.

The concentrated milk preparations, condensed and evaporated milks and milk powders are undoubtedly free of disease-producing organisms as the heat employed in their manufacture will kill the latter. The only possible chance of these products aiding in the dissemination of an infection is in the case of opened cans becoming contaminated by flies, either in an insanitary establishment or in the homes.

As a means of transmitting disease, cream requires the same close sanitary attention (including rigid inspections, pasteurization, examination of milk handlers, etc.) as does whole market milk, for the infectious diseases transmissible by the latter can be conveyed by infected cream. Concerning the other milk products as factors in the causation of disease, the following outbreaks in this country have been traced to infected products: In thirty-six typhoid outbreaks caused by milk products, ice cream was held as the medium of infection in thirty-two, butter in two, cheese in one, and buttermilk in one. Ice cream was considered as the cause of one outbreak of paratyphoid fever, two outbreaks of septic sore throat, one of scarlet fever, and one of diphtheria. Butter was also found responsible for one outbreak of diphtheria.

Butter and cheese made from the milk of animals suffering from foot and mouth disease are known to have produced infections. The tracing of cases of infection to butter and cheese is more difficult than with milk, cream or ice cream. Botulism and various gastro-intestinal disorders have also been traced to some infected cheeses. Generally speaking, however, typhoid bacilli causing typhoid fever cannot survive in sour milk, cheese, or butter for any length of time, and in their relationship to the spread of infectious disease, cheese and butter as marketed from clean milk are not big factors except in regard to the spread of tuberculosis. The use of milk from tuberculin-tested cattle as the starting point to make these products and periodic health examination of those employed in the milk industry to eliminate tuberculous milkmen are precautionary measures which have done much in reducing the possibility of infection of these products with tubercle bacilli.

Ice cream ranks next to milk as an important factor to consider in milk-borne epidemics. It is consumed in larger quantities than any other milk product or milk preparation and it is not kept around for prolonged periods of time as in the case of other milk products. The low temperatures in freezing do not free it from all disease-producing bacteria. The use of efficient and sanitary methods in modern plants

and the introduction of the pasteurization of the mix have practically eliminated the possibility of ice cream so treated from serving as a source for the spread of disease. Where ice cream has become involved, it was usually found that the preparation was made in homes, in small poorly equipped plants, or in establishments where the proper sanitary precautions were not observed. It is also possible for a retailer to infect a high quality product by the use of unclean dippers, other utensils, etc., when the latter are employed.

SPOILAGE OF MILK PRODUCTS AND MILK PREPARATIONS

Unless care is observed in the preparation of the concentrated milk products, the latter will decompose. Evaporated milks, unless properly prepared and sterilized, will undergo various types of fermentation with the production of gas, coagulation, disagreeable odors, bitter and other off-flavors. In some instances the techniques employed in preparation and even the method of sterilization may not be at fault, but the responsibility may rest with minor defects in the cans or containers. Gas fermentation results in the production of so-called "gassy" or "blown" cans, the latter revealing a bulging, particularly at the ends of the cans, and sometimes there appears a bursting along the seam. Not all bulging of cans is, however, due to gas formation caused by bacterial action, which also usually reveals an undesirable odor and other changes. If the cans are filled with a preparation which is very cold, after sealing and processing, they will frequently display a bulging when exposed to room temperature due to the expansion of the contents. Variations in atmospheric pressure may also aid in the production of this bulging. In rarer instances, bulging or swelling may result as a distinct chemical action due to the acid present in evaporated milk affecting the metal of the containers, resulting in the production of a gas (usually hydrogen).

In sweetened condensed milk, unless care and sanitary conditions are observed in the preparation of the latter, bacteria may get in from the plant equipment or by flies finding their way into the product after preparation and before the cans are filled. There may result gas formation with the bursting of the cans along the seams, a thickening of the preparation with the production of an abnormal flavor and aroma, and the development on the surface of small button-like masses of variable size, the latter being referred to as buttons.

Spoilage of milk powders is most frequently revealed by the production of a characteristic stale odor and taste, a darkening and

even hardening of the product and a decrease in the solubility of the latter. Whole milk powder may reveal additional changes in which there may appear the development of a rancidity and tallowiness of the fat. The complete exclusion of moisture and outside air will prevent such deterioration.

In the case of fermented milks, with the exception of Acidophilus and Bulgarian milks, a low temperature (40° F. and lower) is the most satisfactory method of keeping these preparations in the desirable condition. After the fermentation is complete and the desirable stage of development has been reached, proper storage in the cold will prevent any further acid production. Other organisms, especially yeasts and molds that may have found their way in the preparation. will have their growth materially delayed by the cold, thus preventing the production of the yeasty and moldy flavor and aroma in such preparations. Acidophilus and Bulgarian milks being employed primarily for their contents of these two respective organisms are best kept at room temperature to preserve the largest number of viable bacteria.

Objectionable butter and cheese, in which there prevails specific flavor defects, color changes, and undesirable aromas are due to the fact that there was not sufficient attention given to the cleanliness in the surroundings of the factory and dairy, that the cream or milk was not as fit as it might have been, the bacteriologic control in the production of the end products was not observed with the care which was necessary, or that the packing and storage were unsatisfactory. The principal method of controlling the deterioration of butter and cheese as well as all other dairy products is through careful packing or storage in closed receptacles, and the use of low temperatures.

Cream and ice-cream require the same close sanitary attention and refrigeration as does liquid milk, the cold temperature employed in the case of ice-cream being of course much lower.

CONCENTRATED MILKS

Considerable quantities of sweetened, condensed and unsweetened evaporated milks are in use. Their introduction was the result of an endeavor to have available the nutritive elements of milk in a safe and palatable form for long periods of time. Due to the advantages of the prolonged keeping qualities of these concentrated milks, their uniform composition, easier digestibility, the fact that refrigeration is not necessary (though, of course, cold will prolong these keeping qualities), and

that there is a reduction in the cost of storage and transportation due to a decreased bulk, they find extensive use in Tropical, Arctic, and remote regions, on ships, and when travelling, in homes for domestic purposes (so that they may be available when milk is needed) and in infant foods, in the manufacture of ice-cream, confections, bakery products, certain soups, etc. In some parts of the world, they are consumed as a confection or spread. They are especially useful in regions where fresh cow's milk is not available, or where the fresh milk supply is limited or of a poor quality. Whole and more frequently dry skim milks are used by bakers and confectioners, and in making of buttermilk. They have, however, found a wide and ever-increasing use in feed for the raising of calves, pigs, chickens, etc. The use of dry skim milk in the diets of the growing chick has been found to prevent coccidiosis. Approximately 50 per cent. of the dry skim milk made in this country is consumed in the baking industry.

Condensed, evaporated and powdered whole milks contain vitamins A, B, D and G in about the same quantity as is present in fresh liquid milk. When these milks are used for infants, they should be supplemented by orange juice or tomato juice, as the latter supplies vitamin C which is lacking in all heated milk products.

It is of interest to point out here that Marco Polo records over 600 years ago that the Tartars employed a milk concentrate. In the "Travels of Marco Polo" (revised from Marsden's Translation and edited by Manuel Komroff), the following is to be found concerning the customs of the Tartars when travelling:

> "They make provision also of milk, thickened and dried to the state of a paste, which is prepared in the following manner. They boil the milk, and skimming off the rich or creamy part as it rises to the top, put it into a separate vessel as butter, for so long as that remains in the milk, it will not become hard. The latter is then exposed to the sun until it dries. Upon going on service they carry with them about ten pounds for each man, and of this, half a pound is put, every morning, into a leathern bottle, with as much water as is thought necessary. By their motion in riding the contents are violently shaken, and a thin porridge is produced, upon which they make their dinner."

Gail Borden was the first to produce condensed milk in this country, and after several attempts he was finally granted a patent in 1856. Charles A. and David S. Page, Americans, founded in Switzerland the Anglo-Swiss Condensed Milk Company in 1865-66. The former who served as American consul at Zurich, Switzerland,

had served as a war correspondent and became impressed with the use of condensed milk by the soldiers throughout the Civil War. Though J. N. Chwander and Joseph House successfully manufactured unsweetened evaporated milk, it was John B. Meyenberg, a Swiss, who migrated to the United States and who first produced this product on a large scale, receiving patents in 1884 and 1887.

Evaporated and condensed milks are prepared by heating a clean, good quality milk in a vacuum pan at a temperature of 135° F. to about one-half of its original volume. Condensed sweetened milk, sold commercially as condensed milk, is prepared from the latter by adding cane-sugar and heating the mixture slowly in a vacuum pan until the sugar is dissolved. The finished preparation, in which one part of it is equivalent to approximately two and a half parts of fresh whole milk, contains from 40 to 42 per cent. cane sugar, 28 per cent. milk solids (of which 11 to 13 per cent. is milk-sugar, 9.5 to 11 per cent. is protein and 8 to 9 per cent. is fat), and approximately 25 to 28 per cent. water. The Standard Requirements call for not less than 28 per cent. of milk solids and not less than 8 per cent. fat. The high sugar content prevents bacterial decomposition and also freezing, so that sweetened condensed milk can be employed conveniently and is used extensively in cold regions. The product after being condensed to the proper volume is cooled to about 70° F. by mechanical refrigeration. It is filled by automatic filling machines into sterile tin cans, which are then hermetically sealed. On a commercial scale it is possible to make use of vacuum pans to concentrate the milk, as under such conditions a lower degree of heat can be employed and thus the danger of scorching is lessened.

Evaporated or unsweetened milk does not contain added sugar. It is the milk which has been condensed, homogenized, placed in sealed cans, and the latter sterilized under pressure at a temperature between 225° F. and 245° F. for fifteen or more minutes. The heating must not be too intense or severe as certain undesirable changes develop. It must however be sufficient to kill the micro-organisms present. After sterilization, the cooled sealed cans are well agitated to break up the curd, which usually forms during sterilization. Homogenization as employed here is a very important process for it breaks up the fat globules and blends them with the milk, so that they will not separate on standing. The cans are then incubated in the plant for several weeks so as to detect leaky and incompletely sterilized containers. The appearance or agitation of the latter reveals defective

cans. The finished preparation contains approximately 25 per cent. to 27 per cent. milk solids, 8 per cent. fat, and 70 per cent. to 74 per cent. of water. The general requirements are that it should contain not less than 25.5 per cent. of milk solids and not less than 7.8 per cent. of fat.

Commercially condensed and evaporated milks, if unopened, will keep indefinitely. After opening, evaporated or unsweetened condensed milk must be handled just as fresh milk, as it is liable to become contaminated with bacteria and decompose. Sweetened condensed milk will keep for fairly long periods of time even in an open container, for the large percentage of added sugar, always present, aids in its keeping qualities.

Condensed and evaporated skim milks (made from fresh milk which has had the fat removed) are also available. Condensed skimmed milk should contain not less than 20 per cent. of milk solids.

In 1929 in the United States, there was manufactured approximately one and a half billion pounds of evaporated milk (unsweetened), or to be exact 1,499,644,000 pounds. In addition to this 153,624,000 pounds of skimmed and 151,662,000 pounds of unskimmed evaporated milk in bulk were used by bakers, confectioners and others, making a total of 1,804,930,000 pounds of evaporated milk manufactured in 1929. During the same period (1929), in the manufacturing of condensed milk we find there were 1,632,000 pounds of skimmed and 145,922,000 pounds of unskimmed and in bulk 202,475,000 pounds of skimmed and 51,689,000, making a total of 401,718,000 pounds of condensed milk (skimmed and unskimmed). In 1930, in this country, there was manufactured 1,650,000 pounds of skimmed evaporated milk (unsweetened) and 1,449,149,000 pounds of unskimmed evaporated milk, 156,212,000 pounds of skimmed evaporated in bulk and 128,203,000 pounds of unskimmed evaporated in bulk, making a total of 1,735,214,000 pounds of total evaporated milk. During the same year, in the manufacturing of condensed milk, there was produced: 2,092,000 pounds of skimmed and 121,626,000 unskimmed condensed milk and in bulk, 158,971,000 skimmed and 62,421,000 unskimmed condensed milk, making a total of 345,110,000 pounds of condensed milk (skimmed and unskimmed).

DRIED AND POWDERED MILKS

Whole and skim milks are available in dried or powdered form. They, the most concentrated forms of milk which are marketed, are prepared by various processes, which depend upon the removal of most all of the water in

the original fresh good quality milk. The valuable milk solids are left practically unchanged. The spray and roller processes are in general use. In these techniques, a good quality of liquid milk is heated in a vacuum so as to reduce the water content. After pasteurization, the condensed product in the spray process is forced under high pressure through fine nozzles into a steel chamber in which the temperature is about 270° F. The water or moisture present as it volatilizes rises and the remaining powder drops to the bottom of the chamber, from which it is removed. In the roller process, the condensed milk is poured upon revolving steel drums, heated to a high temperature. As the dry powder forms, it is automatically scraped from the drum. In both instances, the entire operation takes but a few seconds and the end products are placed in tightly, closed tin or similar containers. The processes of preparation affect the properties of the milk less than that of condensing. However, the spray process is preferred as this method produces a very soluble powder (without the necessity of adding alkali) and there is less tendency for fat globules to separate. In some of the roller techniques, small quantities of alkali may be added to the finished preparation to render the milk product more soluble in water. Milk powders prepared from skim milk keep better than whole milk powders as the fat in the latter has a tendency to turn rancid or tallowy. The average composition of these dried milks are:

	Water	*Ash*	*Fat*	*Protein*	*Lactose*
Dried Whole Milk	1.6%	5.5%	28.1%	26.8%	38%
Dried Skim Milk	4.4%	8.2%	2.25%	35.1%	50%

The work of the U. S. Public Health Service in the City of Boston during 1919 in co-operation with the Boston Baby Hygiene Association, the Boston Health Department and other agencies established the safety, usefulness and value of dried milk powder in infant feeding on a practical, community and wide basis. Dried milks like fresh milk vary considerably in their antiscorbutic vitamin content. The diet of the cow has a marked effect upon the antiscorbutic content of milk. Twenty c.c. of summer milk is better than 60 c.c. of winter milk for this purpose. One pint of fresh milk per day is needed to protect from scurvy. Fresh milk, high in antiscorbutic vitamin, when dried at a low temperature will yield a milk powder which if protected from air, light, alkalinization (an alkaline environment) and used within a few months after manufacture will always be

found to be high in antiscorbutic value. Generally speaking, as mentioned, dried milks, like fresh milk vary considerably in their antiscorbutic vitamin content. The latter is absent in condensed and evaporated milks. It is therefore best to include an antiscorbutic (as orange or tomato juices) in the dietary when dried or concentrated milk is employed as the sole milk for infants. Vitamins A and B, the antixerophthalmic and antineuritic factors are of equal value in dried, condensed and fresh milks. Vitamin A is not affected by the concentration process as employed in evaporated milk but it is possible that vitamin B may be very slightly reduced in this process. As far as known, vitamins D and E, the antirachitic and antisterility factors present in fresh milk (the latter only in extreme small quantities) are not affected by the heating processes.

Skim-milk powders, are however deficient in vitamins A and D, as these have been largely removed with the fat.

Standard Requirements call for powdered (dried) whole milk to contain not less than 26 per cent. of fat and not more than 5 per cent. of moisture. Each pound of powder represents approximately eight pounds (or four quarts) of the original liquid milk. Powdered (dried) skimmed milk should contain not more than 5 per cent. of moisture.

ADVANTAGES OF POWDERED MILKS

The dried milk powders when mixed with water in proper portions compare favorably as to odor, taste, appearance, etc., with the original fresh milk employed in their production. Due to their satisfactory and even better keeping qualities, to their uniformity, convenience, cleanliness and stability, to an even greater decrease in bulk than condensed or evaporated milks, and cheaper production costs than is required for the latter products, dried milks are gradually replacing all other concentrated milks as superior products. During the past ten years, I have had the opportunity of handling several brands and numerous cans of milk powder. The contents of many of these freshly opened cans of whole milk powder were mixed with sterile water in the proportion of one part of powder and seven parts of water. The bacterial contents of these re-made milks were determined and in no instance did I ever obtain more than 1200 bacteria per c.c. and in most cases the findings were much lower. This reveals a bacterial content even lower than found in the best of market liquid milks.

15,440,000 pounds of powdered whole milk and 260,675,000 pounds of powdered skim milk were manufactured in this country during 1930.

The fat, proteins and carbohydrates in milk are relatively unaffected by heating or concentration. Due to the soft flocculent condition of the curd which forms, thus making them superior in their digestibility, and the fact that disease-producing organisms if present are destroyed by the heat used in the manufacture of condensed, evaporated or powdered milks, the concentrated products possess these decided advantages over liquid milk.

OTHER MILK PRODUCTS. MALTED MILKS, ETC.

There are numerous useful preparations which are prepared by adding other substances to milk. Malted milks and special infant foods, chocolate malted milk and chocolate milk serve in making whole milk more agreeable, and in the case of the first three mentioned products, foods are available which are high in proteid and carbohydrate contents.

In making malted milk, the liquid obtained from a mash of ground barley, malt and wheat flour is mixed to whole milk and to this is added some salt and bicarbonate of soda. The mixture is then dried to a powder, the finished product containing not more than 3 to 4 per cent. of moisture. The keeping qualities of these preparations are similar to those of powdered milk. In this country, 22,691,000 pounds of malted milk were manufactured during 1930.

ICE CREAM

Ice cream is a frozen product made essentially from a good grade milk, cream or milk products, and containing sugar, gelatin or gum, flavored with various extracts, flavoring agents, fruit juices, coffee or chocolate, etc., and to which nuts or fruits may have been added.

The main source of fat in ice cream (present to the extent of from 8 per cent. to 16 per cent. and legal requirements in many communities call for not less than 14 per cent.) is from cream diluted with milk or skim milk, or from melted butter which has been homogenized with milk or skim milk. The "filler," another important constituent of ice cream, and that which supplies to the latter the so-called body, consists of milk solids, supplied from condensed or dried milks or skim milk and other solids as cornstarch, dried eggs, etc. The "binder" is usually gelatin or gum tragacanth, and as a stabilizer it functions by holding the various constituents together, resulting in the product possessing a smooth texture and a greater richness of taste. The mixing of fat, filler, binder and sugar in suitable proportions is spoken

of as preparing what is known as the "mix." This is homogenized or emulsified. In order to keep the bacterial content in ice cream down to as low a quantity as possible, the "mix" is first pasteurized. Coloring and flavoring materials are added, and the whole mixture is frozen by a carefully controlled refrigeration process. The ice cream is then removed from the freezer, placed in hardening receptacles in the refrigerator room (where there is a marked reduction in the temperature) and finally packed for shipment ready for human consumption. Packed in "dry ice," ice cream can be kept for many days. In fact, such a package recently made a twelve-day journey from Seattle to Berlin.

The two distinct classes of ice cream are the plain and frequently referred to as the Philadelphia grade and the French grade. They are both practically the same grade with the exception that a heavy custard is added to the latter. In addition to these grades we hear also of the nut, fruit and bisque ice cream.

Under this class of products we may also find the following: soufflés, mousses, parfaits, puddings, ices, sherbets, etc. Soufflés, mousses and parfaits are not frozen in ice machines. In the first instances, the mixture is placed into suitable soufflé cases and for mousses into bombe moulds and placed in an ice cave to become cold. Parfaits are flavored with liquors and fruit purés. There are many varieties of water ices, frozen mixtures of water and flavoring agents. Milk or its products are absent. Almost any fruit has its counterpart in a water ice. Sherbets are usually flavored with liquor and frozen rough.

Bacteria in ice cream and in frozen products come from the materials used and from the contamination incident to the manufacture and handling. It may be the cream or milk derivatives employed, the gelatin, sugar, the fruits, and to a minor extent the other flavoring materials. It is therefore important to employ good, clean ingredients. Due to the complicated construction of the freezers, homogenizers and other mechanical devices employed in the manufacture of ice cream and the fact that they serve as serious sources of contamination, great care is to be observed in sterilizing thoroughly all equipment and utensils. General sanitary conditions in the plant, the elimination of carriers and cases of disease among the plant employees, and guiding the personal habits of the individuals involved, are closely watched and carried out. The use of comparatively high temperatures in the

pasteurization of the mix in order to secure a pronounced destructive effect on the organisms has resulted in a marked reduction of the bacterial content. Here high temperatures are not objectionable, as the heated flavor produced is later masked by the flavoring agents, and any separation of fat is overcome by homogenization which is later instituted.

Manufacture of ice cream in modern plants, using high-quality ingredients, properly sterilized equipment, keeping contamination from human and other sources down to a minimum, satisfactory methods of pasteurization and homogenization, and no contacts with humans, etc., after pasteurization and until placed in suitable containers have resulted in the production of a high-quality product low in bacterial count. It is of interest to point out here that the bacterial content of water sherbets and similar water frozen preparations is low as compared to that of ice cream. This substantiates the usual statement made that the milk products or preparations employed in ice cream are the most important source of contamination.

The annual per capita consumption of ice cream in the United States during 1929 was 3 gallons, or somewhat less than ½ pint (0.46 pints) for each individual per week. This compares with an annual per capita consumption of 2.49 gallons in 1919 and 1 gallon in 1909. In 1909 there were approximately 80,000,000 of gallons of ice cream (all kinds) produced; ten years later, in 1919, there were produced 230,000,000 gallons, and at the end of another decade, or in 1929, there was produced 254,618,000 gallons, approximately three and one-quarter times as much ice cream as in 1909; 240,750,000 gallons of ice cream were manufactured in 1930. The figures herein given are the tabulations obtained from establishments engaged primarily in the manufacture and sale of ice cream, a product which is distinctly of American origin and of but recent development. It does not include the ice-cream produced and sold by small dealers, hotels, restaurants, etc., and that made in the home. Ice cream today has passed out of the class where it was considered simply as a delicacy. Its real food value is recognized and it is a most satisfactory means of indulging in the use of milk or its products. It can and should be employed as an article of all-year-round consumption. Its higher fuel value, due to carbohydrate and fat, has resulted in the naming of this product "frozen heat."

MILK BEVERAGES, DESSERTS AND FERMENTED MILKS

Special milk beverages are being marketed and introduced as preparations more palatable than plain milk. Bottled carbonated milk is available in some quarters. All of them are pleasant drinks useful for those who may find unflavored milk a most satisfactory food, yet to them an unpleasant liquid to consume.

Large quantities of milk and milk products are consumed by humans in the form of nutritious puddings, cornstarch, custard and junket, or, as in the liquids themselves, milk or cream, to be used as an enriching fluid for some other dish supplied as the dessert.

Fermented or sour milks are the result of some fermentation in the milk in which the milk sugar has been decomposed by bacteria, producing in the main acid, but in some few instances there is also produced small quantities of alcohol. The bacteria concerned in the process of milk fermentation are non-disease-producing, and in fact are actually helpful to man.

BUTTERMILK

This, when genuine, is the liquid left after the fat globules from milk or cream have been churned into butter or removed. If the cream which is churned in butter making is sweet, then the liquid buttermilk does not differ from ordinary skim milk, but if the cream has undergone a clean, natural acid fermentation and it is churned when sour (this being the usual practice), the buttermilk resulting has a pleasing characteristic flavor and taste. It has, however, been found difficult to secure a satisfactory buttermilk of high quality from cream which is allowed to sour spontaneously. This is due to the fact that almost any one or more of an almost infinite number of different types of bacteria get in and cause a wide variety of fermentations with the result that the flavor and taste of the end product are apt to be unpleasant. In practice, dairies and manufacturing concerns have found it advisable to market the so-called cultured buttermilks, in which skim milk or whole milk or whole milk (with a portion of the fat removed, that is partly skimmed milk) are subjected to fermentation with known cultures of organisms, the so-called "lactic-acid bacteria," the latter being the same types as employed in the butter industry. In the "starters" containing these organisms are to be found any one or several of the following: Bacillus (Escherichia) lactici, Streptococcus lactis, Bacterium guntheri (this is probably the same as S. lactis), etc. A uniform cultured buttermilk is more readily obtainable on a large scale than if made in the home. A more nearly uniform product is the result, if the milk which is used

is a pasteurized sample, heated to 70 degrees F. or 75 degrees F., and the same culture or starter is added each time. After the milk sours, the curd produced is stirred or churned so as to break it up into fine particles, and the product is promptly cooled and kept at 50 degrees F. Buttermilk obtained as a by-product of butter making is devoid of or contains a very low percentage (0.5 per cent.) of fat. The lactose content averages 5.3 per cent., casein 2.4 per cent., albumin 0.6 per cent., and mineral salts 0.7 per cent. It should contain not less than 8½ per cent. of milk solids, not fat. Many of the commercial buttermilks possess a fat content of about 2 per cent., the presence of the latter making the product more pleasing to many consumers. Salt is sometimes added to bring out the flavor. Fruit juices, extracts, sugar, etc., may be added to suit the taste. Diluting buttermilk with sweet skim milk or whole milk will reduce the thick consistency of the former and which is objected to by some consumers.

KEFIR, KUMISS, ETC.

Alcoholic fermentation may take place in milk as a result of the activities of certain yeasts. Kefir, kumiss, and similar sour milks, which depend upon the production of lactic acid together with some alcohol and the production of gas, have been in common use for many years, especially in the region of the Caucasus and in Asia and Egypt. In Kefir, the milk of sheep, goats or cows is used, and kefir grains, which are convoluted masses of lactic-acid bacteria, and a yeast are added. Kumiss is made from mare's milk in Asia and Russia. "Leben," used by the Arabs and Egyptians, and "dadhi" in India are made from the heated milk of cows, goats or buffaloes. In foreign countries the method of manufacture is rather primitive and contamination may occur. In this country more sanitary precautions are observed when these products are prepared, so that a more carefully supervised and more satisfactory product is the result.

"Matzoon" in Armenia, "yoghurt" in Turkey, the "kisselo mleko" in the Balkan States, the "gioddu" of Sardinia, the "dadhi" of India and "zoolak" are fermented milks having no alcoholic content. The lactic acid present is produced by the Bacillus (Lactobacillus) bulgaricus and other lactic-acid-producing bacteria.

BULGARIAN BUTTERMILK

This is practically a culture of the Bacillus (Lactobacillus) bulgaricus in sterilized skim milk and it is employed as a therapeutic agent with the thought of implanting this organism in the intestinal tract to control the bacterial flora in the latter. The end preparation does not possess a flavor which

is as pleasing as is buttermilk fermented by the usual cultures. Also it has been found that it is difficult to implant this organism in the intestinal tract of humans, and at present the milk employed in intestinal therapy is fermented by Bacillus (lactobacillus) acidophilus, which as a more adaptable intestinal species is more readily implanted in the intestinal tract. Bacillus (Lactobacillus) acidophilus is a normal inhabitant of the intestinal tract of infants and to a lesser degree of adults.

ACIDOPHILUS MILK

Instead of these previously mentioned lactic-acid-producing bacteria contained in milk, acidophilus milk or acidophilus buttermilk is used more frequently in this country and is generally conceded as the most valuable of fermented milks to be used in intestinal therapy or so-called sour-milk therapy. Fresh milk cultures containing large numbers of these viable organisms have been found of value in aiding to change the bacterial flora in the intestines. This preparation is useful in crowding out or suppressing other bacteria which may be found producing putrefactive changes and other disorders in the intestinal tract. Care must be observed in the production of acidophilus milk or buttermilk so as to insure absolute sterility and to avoid outside contamination, as foreign organisms may quickly enter and dominate the fermentation. Sterile precautions are observed throughout. A sterilized fresh milk, partially skim milk or skim milk is inoculated with a pure culture of the organism and the mixture is incubated at body temperature until the milk has curdled. The latter is broken up by agitation, cooled to room temperature, and placed in sterile containers. Unless large quantities of the pure culture are used, it is advisable that when acidophilus milk is consumed for the patient to take with the preparation appreciable quantities of lactose (sugar of milk) or dextrin so that the growth of the organism will be favored. The marketing of commercial preparations of acidophilus milk or cultures of organisms which depend upon lactic-acid production in the intestinal tract should be under expert supervision, as important matters are to be noted, including the viability of the organisms, the numbers present, absence of undesirable contaminants, etc.

MILK CONSTITUENTS AS MARKETABLE PRODUCTS.

CASEIN

One or more of the milk constituents separated from whole milk are removed, and as they are thus obtained or after further treatment, they are marketed as products of value in commerce or as foods. Thus casein, prepared from skim milk or buttermilk, after separation from

the latter by means of a dilute acid, is drained from the whey, washed with water and dried. It is extensively used as an article of commerce, of value in paper sizing (preparing coated or enameled papers), in glues, paints, photographic materials, casein plastics, celluloid, imitation ivory, imitation mica, imitation leather, and linoleum, textile printing and finishing, for ornaments, novelties, waterproofing cloth, as a spreader in insecticide sprays used by agriculturists, and in a more purified state in pharmaceutical preparations, in biological and medical researches, etc.

SUGAR OF MILK

In the evaporation of whey, obtained from cheese-making and that remaining from the preparation of commercial casein, milk sugar or crude lactose is obtained. A purified product is produced by treating the latter. The resulting purified sugar of milk or lactose finds increasingly extensive use in baby foods and other food preparations, in bacteriological and pharmaceutical operations and in chemistry. Lactose is not as sweet and much less soluble than table sugar or cane sugar. It is subject to less fermentation in the stomach and is not as irritating as the latter. Researches have revealed that the taking of liberal quantities of sugar of milk in the food may serve as an important aid in keeping the intestinal tract in a favorable condition, as desirable types of bacteria will grow best in a lactose environment. These then will outgrow the undesirable types of organisms which cause putrefactive conditions. Recent investigations by workers at the University of Wisconsin have also revealed that lactose helps to build up a strong, bony structure in the growing chick. In amounts of from 10 per cent. to 40 per cent. of the chick ration, lactose gave a partial control of rickets; it was half as effective as artificial sunlight in producing strong bones; and it helped the chicks make better use of the lime in their feed.

OTHER MORE VALUABLE CONSTITUENTS

There are various milk products which are of distinct value in human nutrition. Their food value is due primarily to one of the important constituents of milk, though usually all of the other component parts of milk may be present but in small and most frequently in insignificant quantities. The following milk products, which will be considered, fall in this class.

CREAM

Cream contains (qualitatively) the same constituents as milk, but the fat content (of variable concentration) is however present in a much greater proportion than in milk. There is usually present approximately 4.5 per cent. lactose, 2.5 per cent. protein and 18.5 per cent. of fat. In the mineral salts found, there is present a total of 0.087 per cent. calcium, 0.067 per cent. phosphorus and 0.00022 per cent. iron. The minimum legal requirement for sweet cream is that it shall contain not less than 18 per cent. and preferably 20 per cent. of milk fat. If it possesses less than 18 per cent. of milk fat it is known as substandard cream. Cream having less than 30 per cent. but more than 18 per cent. of milk fat is known as light cream; more than 30 per cent. and less than 40 per cent. of milk fat as heavy cream; and cream having 40 per cent. or more of milk fat is known as extra heavy cream. The term "market cream" for an 18 per cent. fat content, and "rich cream" for cream containing 22 per cent. fat are also known. Adulteration commonly practiced in days gone by, adding a thickener, as gelatin or sugar of lime, is forbidden today. The latter is known also as sucrate of lime and is prepared with cane sugar dissolved in water and to which a diluted milk of lime is added. At one time cream was prepared by the gravity process, known also as "setting." The milk was allowed to stand undisturbed, and the fat, which came to the surface naturally, yielded the basis for market cream. In this process, it has been found best to separate the milk so as to produce a cream containing more than 30 per cent. fat. Such cream sours more slowly than a cream of less fat content; being richer, it is therefore higher in price; is easier to handle and cheaper to transport. The cream obtained is cooled immediately after separation. It is advisable not to mix fresh cream with previous skimmings until it has been cooled. Only cooled batches should be mixed as the addition of warm cream to a cold batch would result in the warming of the whole mixture with subsequent danger to a hastening of souring. The centrifugal separation of cream is more frequently employed in commercial operations. There is a saving in time, a greater yield of fat is obtainable, less dirt is present in the finished preparation, less danger of souring, and the richness of the cream is controlled more accurately. Top milk and gravity cream contain more bacteria than skim milk, as the bacteria rise with the cream. In the process of centrifugalization, bacteria drop to the bottom and the cream being lighter than water rises to the top so that separator cream has a bacterial content which is generally lower than the bacterial content of the original milk.

Market cream is graded just as is milk, and the designated bacterial and sanitary requirements and scoring ratings as is found under the grading of milk (and mentioned in the popular science lecture by the author last year) appiy also to cream The fat contents are however as mentioned previously for cream. The heat necessary in pasteurizing cream may at times cause a slight separation of the latter. To avoid this and a possible loss of some of its body, it is a common practice in many creameries to homogenize the market cream. There are present two types of homogenizers. The cream (heated to about 120° F.) is forced under a pressure of 1000 to 3000 pounds (usually 1500 to 2500) per square inch through a very small opening. The fat globules are reduced so markedly in size that they are not buoyant enough to rise and thus the fat will not separate from the liquid milk serum present. Homogenized cream possesses a smooth and uniform body and appears to have a higher butter-fat content than it really has. As the cream comes from the homogenizer it is passed over a cooler and cooled to 45° or 50° F. and placed in clean, sterilized containers. Homogenized cream is not satisfactory for the preparation of whipping cream. The advantages possessed by homogenized cream are therefore objectionable for whipping cream and manufacturing cream. Accordingly the latter creams, which are to contain not less than 30 per cent. of milk fat are made from raw cream, which has been neither homogenized nor pasteurized, and the grades of whipping and manufacturing cream are not based on bacterial counts. Whipped cream is cream into which air has been beaten. The process is in reality a partial churning and a fairly rigid foam is produced in the finished product. The nutritive value is not affected by this process.

SOUR CREAM

Just as a high grade buttermilk (sour milk) is prepared by treating a good quality of whole or partially skimmed milk with a culture of lactic-acid-producing bacteria, so sour cream is prepared by treating a good quality of sweet cream (containing not less than 18 per cent. of fat) with cultures of these same types of organisms. Sour cream is widely employed by various groups of people as a table dish as well as in baking, etc. So that the rich buttermilk and sour cream should maintain a permanent emulsion of the curd, fat and liquid, homogenization is employed. There are some manufacturers who employ small quantities (¼ per cent.) of gelatin or a gum to prevent the "wheying off" (that is the separation of the casein from the liquid). Manufacturers are, of

course, compelled to state the presence of gelatin or other added substances on the labels of such preparations even though the added materials are wholesome and edible and serve a useful purpose, in this case as a stabilizer. A clear cut and definite declaration on the label or package that gelatin has been added or included in the composition of the sample (and after an examination would reveal but a small amount) would signify that the gelatin is not being employed with a malicious intent and as a fraud for the purpose of increasing the bulk of the preparation at the expense of the more costly ingredients. It is, of course, desirable for manufacturers to prepare a stable product by homogenization or other mechanical operation. If a stabilizer is needed it might be best to caution against the use of gelatin in dairy products especially when sold to and employed by religious sects who do not mix meat products with dairy preparations (gelatin is derived from bones, etc.). This is true of the Orthodox and Conservative Jews who adhere to the Kashruth Laws. Manufacturers who want to sell their products must conform not only with all legal requirements but with those regulations as are present in various religious codes and practiced by those who are genuinely interested in a rational and intelligent adherence to the regulations of their faith.

Cream possesses all the nutritional advantages of milk. In addition to the fact that there is an added value to the higher content of fat, vitamin A and probably vitamin D, cream when added to soups, sauces, desserts, etc., improves the flavor and texture of the latter more so than milk.

BUTTER

Butter (or condensed milk fat) is the product obtained by the churning of cream or milk. The latter process causes the fat globules to adhere together into a compact mass, and in this is enclosed a small portion of the casein, the excess of the liquid portion of the milk being later removed by washing and mechanical operations. Butter fat is of a complex composition. In addition to the fat which is usually present in from 80 to 85 per cent., there is to be found 1 per cent. protein, 0.5 per cent. milk sugar, 0.6 per cent. of mineral salts, 13 to 18 per cent. water, and sodium chloride (salt) to the extent of 3 per cent., if the butter is salted. The legal requirements for butter in this country call for a minimum of 80 per cent. butter-fat; and most states require a maximum of 16 per cent. moisture. In foreign countries we find that the minimum butter-fat requirement is 80 per cent. to 82 per cent, and the maximum moisture

allowed is 15 per cent. or 16 per cent. The butter from the milk of different animals varies in appearance, as for instance human butter is much softer than that from the milk of other animals. In different butters, there are also developed certain odorous principles which are more or less characteristic of the animal from which the butter is taken. All milk fats, concentrated fuel foods and therefore a concentrated source of energy, are composed of essentially the same constituents, although in different proportions. The composition is extremely complex. Butter fat contains a larger variety of glycerides (combinations of glycerin and acids) than any other fat. In addition to palmitin and olein and which it contains in large quantities (almost 75 per cent.), there is also present stearin (approximately 2 per cent.), these three constituents (known also as the "base" fats or the non-volatile fats) being present in most fats. The remainder of its composition is made up of two other non-volatile fats, myristin and dioxystearin and of the glycerides of a number of volatile fatty acids, these fats being peculiar to milk. Chief among them are butyrin, laurin, caproin, caprin and caprylin, which by exposure to light and air decompose readily into their respective fatty acids,—myristic, dioxystearic, butyric, lauric, caproic, capric and caprylic acids. The production of the latter give the peculiar odor and flavor accompanying the rancidity of butter.

The butter-making process consists in procuring clean milk of high quality, and separating the cream either by gravity or still better by centrifugal force, using the centrifugal separator, the latter device being originally introduced in 1878 by Wilhelm Le Feldt of Germany, and perfected for butter-making by a Swedish engineer Gustav De Laval. Before churning, the cream of proper richness (usually 30 per cent. or more of fat) is allowed to "ripen." It has been found that unless the cream is allowed to "ripen," the resulting butter lacks the characteristic quality of flavor to which many of us have become accustomed and which has given it a market value. However more recently, as will be mentioned later, Pasteurized Sweet Cream without ripening is churned for butter-making. The interval of "ripening," at first used on a small scale or on the farm, where cream is allowed to accumulate in appreciable quantities before it is churned to produce butter, is also employed on a large scale for the production of the good grades of butter. It has been shown that the changes taking place in the cream during this period are produced by the action of the bacteria originally present or introduced. At the end

of the period of "ripening" the cream is thick and most frequently sour. There are different varieties of bacteria which participate in this process and determine to a large extent the quality of the end product. The important ones are probably different varieties of lactic-acid bacilli. When the manufacture of butter is carried on in a dairy or creamery where conditions are not controlled, it is chance that determines the kinds of bacteria which take part in the ripening process. In some places, varieties of bacteria which produce palatable and satisfactory butters may have become naturally domesticated. On the other hand, other environments may be laden with undesirable types of organisms which affect the ripened cream by producing objectionable flavors, odors, etc. In practice, preferably pure cultures of favorable bacteria or the so-called "starters" (a previous prepared batch of cream containing naturally bacteria capable of producing the desirable qualities of ripening) are added to the pasteurized cream and the latter is allowed to "ripen." By this means it becomes possible to control those forms of fermentation which, otherwise, due to the presence of contaminating bacteria, would result in the production of the "souring" or "bittering" of butter and the production of undesirable flavors. It avoids the ordinary hit-or-miss conditions which depend largely upon chance to determine the kind of bacteria taking part in the ripening process. The "ripening" process also affects the casein present, so that the latter does not hold the fat globules in emulsion in the cream. Accordingly during churning, most of the fat accumulates into butter granules, leaving but a negligible amount of fat in the remaining sour milk or buttermilk.

The pure cultures which are used by some manufacturers as the "starters" vary in different establishments. All are harmless, lactic-acid-producing bacteria. Many are non-disease-producing streptococci, apparently identical or closely associated with Streptococcus lactis. In butter cultures of high quality, associated organisms are present. The most common ones are Streptococcus paracitrovorus and Streptococcus citrovorus. Both of these organisms (non-disease-producing bacteria) produce volatile acid from lactic acid. It seems also important to control the conditions under which the best results are obtained with these culture.

Churning of the "ripened" cream is conducted at a temperature which varies from 52° to 60° F. in the summer months and from 58° to 62° F. in the winter months. At the completion of the churning process, the buttermilk is drawn off and the remaining butter

present in thick masses and resembling grains of wheat is washed several times with pure, clean water of about the same temperature as the buttermilk. Two washings are usually sufficient. After the wash water has been drained away, the butter is removed from the churn, weighed, and a high-grade table salt (if salted butter is desired) to the extent of one-half to three-quarters of an ounce for each pound of butter is added on the worker. As the butter is pressed upon the worker, the salt is sifted upon it The working is continued carefully until the salt has been evenly distributed and the butter has assumed a desirable grain and body and the proper texture. Overworking is to be avoided, while underworked butter is also objectionable. Butter possesses a high natural color in late spring and early summer, but is usually lighter in color at other times of the year. So as to maintain a uniform color at all times, a few drops of annatto (twenty to thirty-five drops per gallon of cream) a permissable, harmless coloring may be added during the churning by some manufacturers, though many of the commercial concerns do not add this coloring as today the laity accepts a medium or light colored butter. The butter is then packed into earthenware crocks or wooden tubs, which are thoroughly scalded and cooled just before they are filled. Paraffin is usually placed on the surface. It may be made into rolls or prints and then stored in as cold a place as possible, the colder the temperature the longer will the butter keep. Butter, cream, cheese and other dairy products absorb odors which may impart undesirable flavors to the end preparation. Barny odors (manure, etc.), fruit, vegetable and grain odors (onions, beets, silage, clover), gasoline or kerosene from insecticide sprays or cleansing fluids are to be guarded against in places where these products are stored.

Different classes of butter are known in this country:

Dairy butter is butter made on the farm.

Creamery butter is made in a creamery or factory.

Ladled butter is the product made by reworking miscellaneous lots of dairy butter or other butter or both.

Process or renovated butter is the product of melting, refining, and churning, or reworking any variety of butter.

Grease butter is any butter which is unwholesome or unfit for use for ladling or renovating.

It has been found that instead of souring the cream or using a sour cream to start the butter-making, a perfectly fresh sweet

pasteurized cream, churned, without being ripened or soured, at a low temperature and then thoroughly washed will yield a butter which can be kept for longer periods of time with but slight, if any, deterioration. In this process, all utensils are thoroughly cleansed and sterilized and the butter is worked only moderately or just enough to distribute the added salt (if salted butter is the end product desired).

The most common and most objectionable adulteration of butter is the presence of excessive quantities of moisture, the substitution in whole or in part of foreign fat, or in the fraudulent sale of renovated or process butter for the freshly made article. Added chemicals employed illegally as preservatives are objectionable. The consumption of market butter per capita per year in the United States in 1929 was 17.6 pounds or approximately 5½ ounces (5.4 oz.) for each individual per week. In 1928 there was produced in the United States 1,487,049,000 pounds of creamery butter; 1,097,000 pounds of whey butter (made from whey cream); and 2,716,000 pounds of renovated or process butter. In 1929, there was manufactured in this country 1,597,027,000 pounds of creamery butter; 1,221,000 pounds of whey butter (made from whey cream) and 2,531,000 pounds of renovated or process butter; while in 1930 the output was 1,595,231,000 pounds of creamery butter; 2,516,000 pounds of whey butter and 1,850,000 pounds of renovated or process butter. In 1928 when the per capita consumption of butter in the United States was 17.3 pounds, the per capita in other countries was: 34.1 pounds in New Zealand; 29.8 pounds in Australia; 29.3 pounds in Canada; 19.7 pounds in Germany; 13 pounds in Switzerland; 9.9 pounds in Czechoslovakia; 5.4 pounds in Russia (U. S. S. R.), and 3.3 pounds in Austria.

The bacterial content of fresh butter varies considerably and depends primarily upon the method of manufacture. It may be but a few thousand per gram of butter in the case where pasteurized cream and carefully controlled sanitary precautions were observed to several million where sour cream was used or butter cultures were employed to obtain a uniform flavor and aroma. In the former case the numbers of bacteria are of some significance as to the sanitary purity of the sample and the cleanliness observed during the manufacturing process. In the latter case, the total bacterial content (most of which are normal culture organisms) is of very little value though it may be of interest in connection with the study of the deterioration of the sample. The types of organisms present especially those foreign to the product (as yeasts and molds and their numbers) are a better indication of the care used in manufacture.

Fresh butter, possibly the oldest prepared food known (having been discovered by the Aryans) is one of the most palatable, most digestible and most easily tolerated of fats, the coefficient of digestibility being approximately 98 per cent. In addition to this, butter has a special nutritive value, for with the exception of cod liver oil and egg yolk, it is the most abundant source of vitamin A.

CHEESE

It is unfortunate that cheese is so frequently regarded merely as a relish. It is more than a condiment. Cheese should be appreciated as a concentrated palatable food rich in protein, fat and mineral salts (having present the solid part of the milk except all but a small amount of the lactose or sugar of milk), which compares most favorably in nutrition value with meats and other foods, and it can be used with favorable results as a substitute for them. In addition it can be kept for long periods of time without refrigeration.

Cheese consists principally of the curd and fat removed in a mass from milk, which has been curdled by the action of rennet or by the natural souring of the milk. The end product contains 25 to 38 per cent milk fat, 17 to 30 per cent. casein, 30 to 50 per cent. water, 1.5 to 5 per cent. lactose, 2 to 6 per cent. mineral salts (appreciable quantities of phosphorus and calcium), added salt, and with or without coloring. On the basis of water content and according to the mechanical treatment of the curds before the ripening process, whether they are pressed, allowed to drain for weeks without pressure to a firm consistency, or are made in a comparative short period of time and then merely by draining on a sieve and using hand pressure, cheese is classified as hard, medium or soft. On the basis of the original material employed in making the finished product, another classification is known, and we hear of cream, whole-milk or skimmed-milk cheese. Another classification groups the various cheeses into (1) those produced by the curdling of milk due to the action of rennet, and (2) those produced by the curdling due to an acid development. The acid-curd cheeses require no ripening and are consumed soon after being made, as otherwise they deteriorate. The rennet-curd cheeses on the basis of their moisture content are divided into hard and soft cheeses, and intermediate grades are available ranging from the typical hard to the typical soft rennet cheeses. Cheeses are made not only from cow's milk, but the milk from goats, sheep, buffaloes and other animals are employed. Goats', ewes' and other milks rich in fat and protein

are well adapted to the manufacture of cheese, and they are used especially for this purpose in certain quarters. Original and genuine Roquefort, for instance, calls for sheep's milk, though a satisfactory product is made from cow's milk.

Today there are almost five hundred varieties of cheese known all over the world, made from milk of one animal or another, but all differing primarily in the treatment employed in the final process of ripening. The three other steps are in the main almost the same. First, the milk casein is coagulated or solidified into a mass of curd by means of an enzyme as is found in rennet. In the second stage, the curd is gradually heated (about 2 degrees every five minutes) until a temperature of 100° F. is reached, stirring all the time. The mass is then manipulated so as to separate as much whey as possible from the fat and casein. The third step consists in removing the whey, after the curd is firm and the proper amount of acid has been developed. This is then salted, pressed, dressed and compressed into a desirable form. The product now known as "green cheese" is rarely employed and usually only after the fourth and final stage or the curing or ripening process is carried out. It is here where the digestion of the casein is affected and the insoluble curd is changed into soluble or readily digestible substances. The cheese is kept for varying periods of time, from a few weeks to several months and even years, this depending upon the variety of cheese. Other factors which the latter depend upon are the temperature and moisture present during the ripening period, the distinctive odors or flavors present in the environment where the cheeses are kept, or the bacterial content in such air, if "starters" were not used. The holes so often observed in some of the hard cheeses are due to gas production during the process of ripening. Cheeses are in some instances pasteurized before they are marketed and filled by automatic machinery into tins or other suitable containers. Recently New York State dairy specialists have found that a good cheese can be made from frozen milk, with a slight modification of the cheese-making process.

The conversion of milk products into cheese depends upon the action of enzymes and bacteria on the protein present. The enzymes involved are pepsin and galactase, while various lactic-acid-producing bacteria, as the lacto-bacilli and Streptococcus lactis also play a part. The cheese flavors are determined largely by the end products produced in such protein decomposition, which in turn are influenced by

the bacteria present and the cultural conditions prevailing. As to the types of micro-organisms present in various cheeses, much work has been done. Though various molds, yeasts, spore-bearing bacilli and other bacteria have been found causing the "ripening" of the different varieties of cheeses, attempts to produce a definite flavor with pure cultures have met with but moderate success. In many instances the ripening process is due to the activities of different varieties of bacteria, one species after the other gaining the upper hand, with the lactic-acid-producing organisms playing the leading role. It is true that the flavor, aroma, digestibility, etc., of cheese may depend upon bacteria which are capable of peptonizing the curd, but the latter organisms would carry on their activities to the stage of putrefaction were it not for the restraining influence of the acid produced by the lactic-acid bacteria, a reaction which is therefore requisite to a normal ripening. In most instances, in addition to the predominating organism or organisms concerned in the "ripening" process, there prevails a variety of adventitious bacteria. The latter, depending in species and proportion upon the local conditions under which the various cheeses have been produced, have added additional flavors which are characteristic of the particular variety of cheese and have determined its special market value. Off flavors, aromas and color changes in cheese are due to any one of a large number of organisms which may find their way into the cheese in sufficient numbers to produce the undesirable changes which are generally objectionable types of protein decomposition.

Mention was made that almost five hundred varieties of cheese are known. Many of these varieties differ only in name, and they can actually be grouped into about twenty distinct types. Often the differences between them are due to the locality, to the animal milk used, to the breed of animal, to the herbs in the grass or pasture, to the atmospheric conditions, etc. Distinguish if you will the original Roquefort cheese—the king of cheeses—coming from the caves of Roquefort, France, where for 800 years this variety has been made from sheep's milk, and the "ripening" conducted in the natural caves in this territory. "Bastard" caverns have been utilized by manufacturers, but these artificial caves do not produce cheeses possessing the same characteristic aromas, etc. The sheep are found grazing upon fragrant herbs, and the pint of milk yielded daily by each sheep has an aromatic content which adds to the flavor. Italy's attempt to imi-

tate Roquefort resulted in the production of the Gorgonzola; and the Stilton in England is a close relative. The latter cheese is made in Leicestershire and Rutland, England, and seems to be inimitable with its piquant flavor. The Roquefort cheese is a representative of the group of hard cheeses in which there is present a mold growth in the cheese mass or throughout the whole curd during the ripening process. This organism, the Penicillium roqueforti (perhaps the same as or a variety of Penicillium glaucum) is most active in causing the changes and in having so pronounced an influence on the development, flavor, aroma, etc., of the end product. Such a cheese made from sheep's milk possesses a more peppery taste than one prepared from cow's milk. The various kinds of Penicillium, which are the molds particularly active in different cheese ripening, not only exert a proteolytic action themselves but by their decomposition and alteration of the acid products facilitate the action of the peptonizing and other bacteria and they influence the flavor of the end product.

There is the Emmenthal cheese of Switzerland, the Cheddar of England, the Camembert and Neufchatel cheeses of France, the Limburger of Belgium, and the picturesque Edam cheese made in Edam, Holland. The connoisseur can tell whether the Parmesan has been ripened for the proper period of time or whether the Gjetost, served by being cut with a fine wire, is an imitation; and when his Petit Gervais is mixed with strawberries, he can distinguish the true product from another delicacy served in its place.

The Swiss or Emmenthal cheese, a typical hard cheese (which is ripened by bacteria without the intervention of molds), possesses a sweet taste, a firm, elastic texture, and is characterized normally by the formation of eyes or gas holes. The latter are very important in a Swiss cheese. They are well distributed, ranging from one-half to one and one-quarter inches in diameter, and are spaced so that there is from two to several inches between the holes. Bacteria are responsible for this eye-formation, and it is the carbon dioxide, one of the gases formed by the action of this organism (Bact. acidi propionici or propionibacterium) which is the important gas present in these eyes or gas holes. Due to a limited growth of this organism or due to its absence in Swiss cheese, the latter may fail to develop eyes or holes. There is of course the possibility that in some instances objectionable organisms may contaminate the cheese, producing abnormal flavors and aromas and even excessive amounts of gas, so that large numbers

of irregular gas holes may be present, giving the cheese an abnormal appearance in shape, etc. The remedy here as well as in the production of butter and other cheeses of a desirable character lies in a most careful attention to cleanliness in the surroundings of the dairy or plant and in a vigorous bacteriologic control of the actual production and ripening process.

The Camembert cheese is a rennet-curd cheese of the soft type. The ripening is brought about through enzymes elaborated by microorganisms growing at the surface. The characteristic mold of this cheese which gives the latter its texture is Penicillium camemberti (P. candidum, closely allied to the common blue-green mold P. glaucum). The latter produces a felted mass on the surface, which may penetrate about one-sixteenth of an inch into the curd. The characteristic Camembert flavor is due mostly if not entirely to a widely distributed yeast-like organism (Oidium lactis) and it seems that the characteristic flavor and aroma of this cheese depends upon maintaining a proper balance between the Penicillium or mold and the Oidium or yeast.

Cottage cheese belongs to the group of unripened cheeses in which the curdling of the milk is produced by acid development, usually formed by adding a butter culture to pasteurized milk. The use of cream results in the production of cream cheese. The addition of pimiento peppers or pineapple yields pimiento-cream cheese or pineapple-cream cheese. Care is to be observed in the making and packing of cottage cheese so as to keep out molds and yeast. Low temperatures are essential to control any deterioration.

In the United States, all types of cheeses are to be found. Many are imported and cheeses characteristic of many of the foreign group are produced in this country. The soft cheeses, which are more perishable than the hard cheeses and therefore higher in price, are represented by the Brie and Neufchatel, both French cream cheeses, which are imported and also produced in this country. Stilton, an English, and Gruyere, a Swiss cheese, belong to the medium class. Cheddar (which is the common cheese of the United States, originally and still made in England), Flats, Parmesan, Caciocavallo and Pecorino (Romano) are types of hard cheese. Other varieties found in this country are Camembert, a rich cream cheese; Edam, a round, mild, long-keeping Dutch cheese; Emmenthal (Swiss), a hard cheese; Limburger, Longhorns, Munster, Philadelphia Cream, Provolno, Roquefort, Sap

Sago, Square Prints, and Young Americas. In this country various standards have been fixed by the Government or by State statutes, in which the products are graded and sold on their butterfat content, the richer grades naturally selling for a higher price. Cheese when adulterated is one either prepared from a skimmed milk or by the partial or total substitution for the milk fat of a foreign fat as lard, etc. Such products are, of course, inferior, and it is illegal to sell them as pure cheese. The following will give the *average* moisture, protein and fat contents of different varieties of cheeses found on the American market and analyses made from various samples at different times by the author:

	Water, per cent.	*Protein, per cent.*	*Fat, per cent.*
Brick	43	20.5	31
Brie	50	17	25
Camembert	48	20	27
Cheddar	36	25	33
Cream (Full) (mean)	39	20	42.5
Cottage (mean)	75	17	1
Edam	35	25	30
Neufchatel (mean)	47	18	29
Roquefort	38	24	32.5
Stilton	30	29	35
Swiss (mean)	32	25	34.5

(Mean) of many examinations.

The different varieties of cheeses are usually packed in characteristic containers or molded into specific shapes, sizes and weight, and definite numbers are packed in a box, tub or crate. Neufchatel cheese, possessing an average weight of 2½ ounces, and an approximate size of 1 inch by 2 inches is generally packed 25 to the box; Philadelphia Cream, 3 ounces, 3 by 2 by 1, is packed 12 to a box; Camembert, 1½ ounces, in triangles 2 by 2 by 1½ inches, is usually shipped six in a box, etc. The hard cheeses are molded into round or desirable shapes of heavy weight and are packed in tubs, boxes or cases. Emmenthal (Swiss) cheese averages from 150 to 225 pounds and a size of 30 by 38 by 6 to 8 inches; Cheddar is approximately 70 pounds in weight, a diameter of 13 inches and a height of 15½ inches, etc. The following observations of imports, exports and production

of cheese in the United States as made by the United States Department of Agriculture are of interest:

	Imports pounds	*Exports pounds*
1890	9,263,573	95,376,053
1900	13,455,990	48,419,353
1910	40,817,524	2,846,709
1915 (war period)	50,138,520	55,362,917
1919 (after war)	2,442,306	18,794,853
1920	17,913,682	19,378,158
1922	46,573,099	5,006,574
1924	59,175,591	4,299,127
1926	78,416,823	3,902,597
1928	80,432,272	2,599,947

The four countries sending the greatest quantity of cheese to the United States are Italy, Switzerland, France and Greece. The amount imported from these countries in 1926 in the order named was 35,026,000 pounds, 16,736,000 pounds, 5,424,000 pounds, and from Greece 2,570,000 pounds. The following table gives the cheese production in this country (in pounds):

Kind of Cheese	1918	1922	1926	1930
Cheddar				
Whole milk	253,634,000	282,806,000	335,915,000	378,816,000
Part skim	8,313,000	2,164,000	2,927,000	3,653,000
Full skim	6,110,000	2,500,000	1,384,000	669,000
Swiss	19,363,000	19,983,000	20,883,000	26,393,000
Limburger	8,467,000	7,383,000	9,639,000	8,473,000
Italian varieties	4,835,000	2,627,000	2,425,000	8,573,000
Brick and Munster	41,376,000	37,194,000	31,048,000	33,548,000
Cream and Neufchatel	5,639,000	9,936,000	18,192,000	33,213,000
All others	8,986,000	5,378,000	5,003,000	7,029,000

The annual per capita consumption of cheese in the United States in 1929 was 4.62 pounds, or slightly over 1⅓ ounces (1.38 ounces) of cheese per individual per week. There is no reason why this per capita consumption should not be increased, for cheese is more than a delicacy. It is a staple concentrated food, with practically no waste. This real food value is too often unappreciated. Cheese eating is within the means of everyone, not only the epicure, who generally is more epicurean about his cheese than he is concerning any other food or drink. Its use with moderation and proper balance can greatly be extended either as the main dish, as an appetizer or to

supply the proper nourishment to other foods lacking the latter, but which are perhaps more inviting or appetizing; or cheese can be served as a dessert. Always available, convenient to serve in almost all kinds of attractive ways, highly nutritive and comparatively cheap in price are sufficient reasons to command a greater use of the cheeses suiting one's fancy.

RECONSTRUCTED OR RECONSTITUTED MILK

This is obtained by blending together the constituents of milk previously separated. In regions where fresh market milk and cream are not available, reconstructed milk and cream can be used by the ice cream and other industries and as the fluid milk and cream to be furnished in the home, provided it is sold under its own label and with information as to its source and method of preparation. These products are made from dried skim milk, sweet (unsalted) butter, and a fresh sanitary water; from whole-milk powder or evaporated milk and water; or from evaporated skim milk, water and butter. In the manufacture of reconstructed milk and cream, sanitary precautions in the operation of the reconstruction plant and in the marketing of the finished preparation are just as necessary as is the handling of fresh milk. The chemical and bacteriological standards of the end product must be equal to that of normal fresh market milk, and the ingredients used in its production must meet all the legal and sanitary requirements. Reconstructed milk or cream can be made in quantities which will more closely parallel that of the demand than is possible with fresh milk. In localities where transportation facilities are poor or irregular, so that perishable liquid fresh milk would be a problem, reconstituted milk might be both convenient and economical as the constituents employed in its manufacture keep and can be stocked for future use.

MEDICAL AND PHARMACEUTICAL NOTES

POISON SPRAY MATERIALS DRIVE OFF JAPANESE BEETLES—Japanese beetles find lead arsenate so disagreeable that they leave foliage sprayed with it, without eating enough to poison them. Other spray materials repel them in similar fashion, even when they are not poisonous. These include such things as slaked lime, barytes, chalk and china clay. Paris green, however, proved attractive to the beetles in some of the experiments.

This has been demonstrated by E. R. Van Leeuwen of the U. S. Bureau of Entomology, in a number of experiments. He found that in general most of the beetles, will leave a tree within three hours after it has been given a lead arsenic spraying, while many new arrivals merely hover in flight and refuse to alight.—*Science Service.*

ACETIC ACID MADE DIRECT FROM WOOD—A new method of producing acetic acid direct from wood without first producing acetate of lime has been used successfully in a chemical plant in Memphis, Tenn., and has just been introduced into the plant of an associated interest in Crossett, Ark., Emerson P. Poste has reported to the American Chemical Society.

The process, which was devised by a Viennese chemist, Hermann Suida, is hailed as wresting victory from defeat for the wood distillation industry which has been so hard hit by the development of synthetic methanol and synthetic acetic acid.

The resulting acetic acid is of sufficient purity to be used commercially without further refining, and is used chiefly in the manufacture of solvent esters, such as butyl and ethyl acetates, important as solvents for lacquers.

The by-products of the process are also of considerable commercial importance. From a single cord of average hard wood, it is reported that the following products are obtained: charcoal, 1330 pounds; oil for wood preserving, etc., 4.5 gallons; pitch 40-45 pounds; acetic acid 120 pounds; and methanol, 9 gallons.—*Science Service.*

CALCIUM AND PHOSPHORUS TO THE FRONT AGAIN—Eating simple salts of calcium and phosphorus to build strong healthy bones

may also lengthen the prime of life and delay the onset of old age, Prof. Victor K. LaMer of Columbia University, New York, has determined from a review of the work of other scientists.

If the proper amounts of calcium phosphate, a chemical now added to common salt to prevent it from caking in moist atmosphere, were eaten, life might be prolonged some ten per cent. Those who would normally die at 70 might continue to live until 77, Prof. LaMer believes. The specter of old age, the appearance of senescence, would be pushed farther into the future.

Young people, mothers and those in the prime of life will also be benefited by these essential mineral salts in their food. Experiments on rats by Prof. H. C. Sherman and Dr. Louise Campbell of Columbia, with whom Prof. LaMer has been working, have shown that rat mothers, and presumably human mothers, produce babies earlier and longer and raise more children when given a proper amount of these salts in the form of milk powder.

By building strongly calcified bones such as result from a high intake of calcium and phosphorus in the diet, the prime of life can also be prolonged, Prof. LaMer contends.

Calcium and phosphorus can best be supplied to the body by eating liberally of milk and leafy vegetables, but it has also been shown that certain organic salts of the two elements can function as well as organic forms, such as occur in foods, in meeting the deficiencies of these elements.

Prof. LaMer and associates have worked out a "solubility product principle" by which it may be determined in just what proportion the two elements should enter into the diet to give the best result. Both calcium and phosphorus must be added as the inclusion of just one element may cause trouble.

Decay in teeth may be caused by inadequate amounts and proportions of these two vital bone-building elements. Prof. LaMer recalled the work of Prof. E. V. McCollum of Johns Hopkins on tooth decay in rats.

It is to be expected that some sort of calcium phosphate will in the future be added to common table salt just as iodine is now added to salt in regions where ordinary food is lacking in this element essential to prevention of goiter.

Growing children require twice as much calcium in their food as a normal adult, and mothers need three times that required by other adults.

Prof. LaMer warned that improper bone formation cannot always be detected by body weight, and malformed bones may be affecting health for long periods without the person's realizing his condition.

Although important, vitamin D and ultraviolet light cannot substitute for the proper amounts of calcium and phosphorus in the diet, Prof. LaMer explained.—*Science Service.*

PHARMACISTS: LIABILITY FOR QUALITY OF DRUGS SOLD—A druggist, under section 5813 of Mason's Minnesota Statutes, 1927, is responsible for the quality of all drugs, chemicals and medicine sold by him, except proprietary medicines and other articles sold in the original packages of the manufacturer. In the opinion of the Supreme Court of Minnesota, this section was not enacted to relieve druggists of responsibility, but was enacted for the additional protection of the public. At common law, a druggist is bound to exercise toward his patrons that degree of care which is commensurate with the hazards and dangers to which they are exposed. Only as to the quality of non-proprietary medicines has the statute undertaken to define the responsibility of the vender. In other respects and as to proprietary medicines, the law requires the same degree of care that was required at common law. In connection with the sale of proprietary medicine in original packages, the druggist is not required to analyze the medicine or drug, when sold for the purpose for which compounded, and if the manufacturer is a reputable one the druggist may rely under ordinary circumstances on the rectitude of the manufacturer and the correctness of his compound. Ordinary care under such circumstances does not require a greater degree of diligence. But when a druggist obtains from a manufacturer drugs which he does not sell under the name of the manufacturer, but under his own name, accompanied by a statement that it was manufactured or prepared for him, the druggist assumes a responsibility equivalent to that of the manufacturer of the drugs. The word "proprietary," as applied to medicines, necessarily implies that the medicine has been compounded by a manufacturer who prepared the medicine according to his own formula, though probably it is not necssary that the formula be the exclusive property of the maker or that the process be secret. A medicine cannot be considered "proprietary" unless the original package in which it is contained bears the name of the manufacturer. If it does not, it comes within the rule applied to other medicines and drugs sold by a druggist, for the quality of which the statute holds him responsible

(Tiedje v. Haney (Minn.), 239 N. W. 611.)—*Through J. A. M. A.*, 99:7, 588.

Tannic Acid and Acriflavine for Burns—W. C. Wilson advises the treatment of burns and scalds by means of a coagulating solution sprayed from an atomiser onto the raw surface and dried immediately by a current of hot air from an electric drier or simply by the heat from electric bulbs. The solution is prepared by dissolving tannic acid 2.5 per cent. and acriflavine 0.1 per cent. in sterile water. Packets of the mixed powder containing 7.5 gm. of tannic acid and 0.3 gm. of acriflavine may be kept in readiness and the solution prepared by dissolving the contents of one packet in 300 cc. of warm sterile water. The solution should be made freshly for each case or occasion, but not necessarily for each application. In the case of extensive and serious burns the area must be cleansed and the solution applied whilst the patient is under an anæsthetic; seven to ten applications being necessary in the majority of cases.—*Through Phar. Jour.*

Mercurochrome as a General Antiseptic—A. V. Elder describes mercurochrome as the most satisfactory preparation offered to the profession as an antiseptic for general external use. Used in solutions of 1 to 5 per cent. it has all the advantages of iodine with none of its drawbacks. In most cases, application of 5 per cent. strength is painless, while a 2 per cent. solution is always so. It does not destroy tissue, and its antiseptic co-efficient is undoubtedly very high. As a counter-irritant, such as iodine, it is useless, and its staining properties may be considered a drawback. These can be counteracted by subsequent painting with 2 per cent. solution of potassium permanganate, followed by 5 per cent. oxalic acid. It affects steel instruments, even some of the so-called rustless variety of hypodermic needles. An aqueous solution was used with success externally in the following types of case: General antiseptic, 5 per cent. in distilled water; conjunctivitis, 0.2 per cent.; carbuncle, 5 per cent. (hypodermically in a known hæmophiliac); erysipelas, 5 per cent. locally, with overlapping of affected area; otorrhœa, 5 per cent. plugs after instillation; gonorrhœa, 1 per cent. instillation, retained for five minutes; septic tonsilitis, 2 per cent. local application; septic cavities, 5 per cent. instillation; site of hypodermic injection, 5 per cent., subsequently sealed, by collodion flexile.—*Through Phar. Jour.*

NEWS ITEMS AND PERSONAL NOTES

NEW PHARMACY DEAN AT PITTSBURGH—Dr. C. Leonard O'Connell, for the past two years associate dean, has been elected dean of the School of Pharmacy of the University of Pittsburgh. Dr. O'Connell received his training in the common and high schools of Pittsburgh and the University of Pittsburgh. Dr. Julius Arnold Koch, dean of the school for forty-one years, and for fifty years actively connected with it, has been elected dean emeritus.

DICKHART APPOINTED OFFICIAL CHEMIST—The Olive Oil Association of America has engaged W. H. Dickhart, of New York City, as its official chemist. Mr. Dickhart was for many years one of the official chemists of the New York Produce Exchange and recently opened a laboratory at 189 Franklin Street. He is a member of the American Oil Chemists Society and the American Chemical Society. He is also serving on the subcommittee for revision of the U. S. Pharmacopœia in connection with organic chemicals, which includes oils and fats. Mr. Dickhart, who is a graduate of the Philadelphia College of Pharmacy and Science and University of Pennsylvania, is making an intensive study of the properties of olive oil and other edible oils, and in addition to serving the Olive Oil Association, is equipped to do the analytical work for the oil trade.

DR. FORAN ADVANCES—Ralph R. Foran, 1917, has been placed in charge of the control division of Merck & Company, Rahway, New Jersey, pharmaceutical manufacturers.

Dr. Foran is known to many hundreds of P. C. P. & S. graduates because he was a member of the teaching staff in chemistry from 1917 until 1925, except for a period during the war, when he was in the chemical warfare service. He left the College in 1925 to join Powers-Weightman-Rosengarten Company in Philadelphia, and when that company merged with Merck two years later, went with them to Rahway in the control division.

Dr. Thornton Honored—Dr. E. Quinn Thornton, 1889, and also a graduate in medicine from Jefferson Medical College, has just been appointed professor of therapeutics in that College. He succeeds Dr. Elmer H. Funk, who died suddenly within a year after his appointment as successor to Dr. Hobart A. Hare.

For thirty-eight years Dr. Thornton was associate professor of therapeutics at Jefferson. At special exercises two years ago in honor of Dr. Thornton, the then senior class at Jefferson presented to their College an oil painting of Dr. Thornton. At that time, Dr. Thornton was characterized as the most universally beloved man at Jefferson